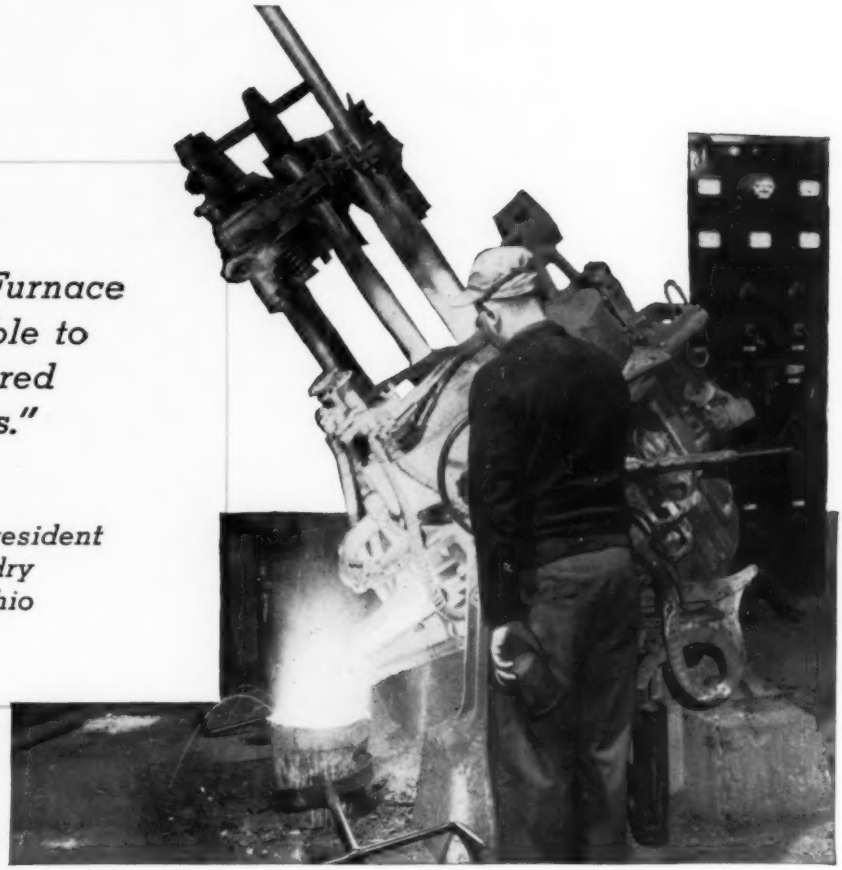
Own

American

This *Lectromelt** controls quality of special gray iron castings...

"Our Lectromelt Furnace makes it profitable to go after engineered castings business."

Frank Dost, President
Sterling Foundry
Wellington, Ohio



Sterling Foundry's 250-lb. Lectromelt Furnace in action. Averaging 400 lbs. per melt, this sturdy furnace is used for producing alloy iron to meet specifications for engineered castings.

When specifications require special alloy iron castings, Sterling Foundry depends on their Lectromelt. It gives the exact control of heat and analysis needed to make today's engineered castings. With metallurgical research finding more and more uses for special alloy castings, specifications are tougher. Yet a good foundry with a Lectromelt Furnace can meet these rigid specifications.

If you can see the extra business potential possible with an electric, write for Lectromelt Furnace information. Our engineers will answer your questions and supply you with catalog information covering all sizes of Lectromelts, from 25 lbs. to big 150-ton steel furnaces. Pittsburgh Lectromelt Furnace Corporation, 316 32nd Street, Pittsburgh 30, Pennsylvania.

Manufactured in . . . ENGLAND: Birlec, Ltd., Birmingham . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa. JAPAN: Daido Steel Co., Ltd., Nagoya

*REG. T. M. U. S. PAT. OFF.

MOORE RAPID

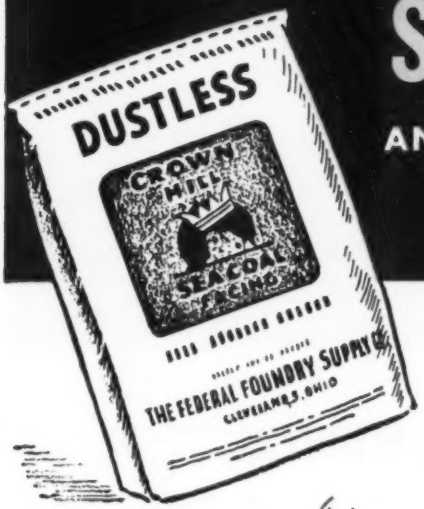
WHEN YOU MELT... *Lectromelt*

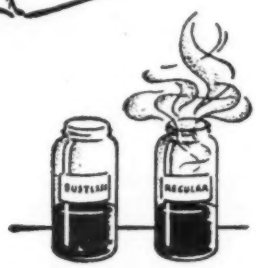
ATTENTION

"GOOD HOUSEKEEPERS"

DUSTLESS SEACOAL

AND PITCH BINDERS





Ask your FEDERAL representative to demonstrate the new "dustless" additives. He'll use two jars of seacoal—one containing "regular" seacoal, the other "dustless" seacoal. When shaken vigorously, and the cap removed, the jar of "regular" gives off clouds of dust. But, *no dust* arises from the jar of "dustless", when it is subjected to the same agitation.

FEDERAL now offers "DUSTLESS" seacoal and pitch binders as a contribution to the movement toward "better housekeeping" in foundries. Chemically treated to minimize dustiness in handling, these sand additives will help provide more healthful working conditions—by substantially reducing skin irritation and dust inhalation. There's economy in FEDERAL "dustless" products, too, despite a slightly higher cost. In addition to the benefits from "better housekeeping", their use holds to an absolute minimum the usual dust-losses in air-swept mixing and handling equipment.

FEDERAL's "dustless" treatment does *not* involve the addition of "wetting agents" that can have detrimental effects on sand mixtures. FEDERAL's is a *chemical* treatment that in no way affects the performance of sand additives.

FEDERAL will continue to stock "regular" seacoal and pitch binders, along with the "dustless" type. But, we strongly urge you to switch to, or at least investigate, our new "dustless" products.

FEDERAL

Make your foundry a better place in which to work!

The **FEDERAL FOUNDRY SUPPLY** *Company*

4600 EAST 71st STREET, CLEVELAND 5, OHIO

CROWN HILL, W. VA. • CHICAGO • DETROIT • MILWAUKEE • RICHMOND, VA. • ST. LOUIS • CHATTANOOGA • NEW YORK • UPTON, WYO.

IN TWIN CITIES: L. D. Caulkins Company, 428 Stinson Blvd., Minneapolis

Molder at Louis Meskan Brass Foundry lifts Edco Dowmetal Bottom Board one-handed.

Notice how its bridge-type construction makes an Edco Board easy to handle, as well as providing resistance to warping and breaking.

"Our EDCO Dowmetal Bottom Boards have paid for themselves in one year...."

says EMMETT TORKELSON, Foundry Superintendent
LOUIS MESKAN BRASS FOUNDRY, INC., CHICAGO, ILLINOIS

"Every one of the 300 Edco Dowmetal Bottom Boards we bought a year ago is still in daily use," says Foundry Superintendent Torkelson. "Further," he says, "our Edco Boards have reduced our scrap loss by helping produce castings true to pattern.

"Edco Dowmetal Bottom Boards are easier to work with. Their design enables the molder to roll the flask with greater ease than is possible with wood boards.

"We figure our Edco Dowmetal Bottom Boards have paid for themselves in one year. This is based on elimination of board repair and replacement, plus scrap savings, since switching from wood boards."

Louis Meskan Brass Foundry, Inc., is a medium-size foundry, casting nonferrous metals, including brass, bronze, copper and lead as well as aluminum.

Whether your foundry is large, medium or small . . . whether you cast iron, steel or nonferrous metals . . . you will find it worth your while to look into Edco Dowmetal Bottom Boards. It's easy to get more information:

Simply write a letter or phone MAnsfield 6-7330 and we'll send you a price schedule and list of 83 standard sizes available from stock.

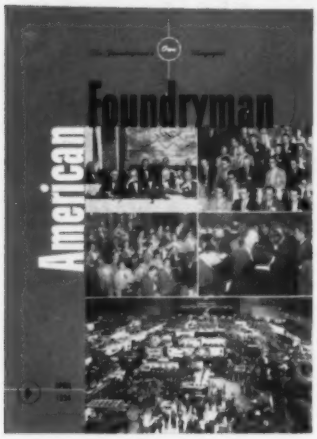
CHRISTIANSEN CORPORATION

210 SOUTH MARION STREET
OAK PARK 2, ILLINOIS
ALUMINUM ALLOY INGOTS

American Foundryman

Volume 25 **April 1954** *Number 4*

Published by American Foundrymen's Society



The Annual AFS Convention and Exhibit features many activities of broad interest to foundrymen in any phase of the industry. Technical sessions, round table luncheons, shop courses, dinners, a multi-million dollar exhibit of foundry equipment and materials—these are indicative of the busy program scheduled for May 8-14 at Cleveland *(See pages 33, 76-78).*

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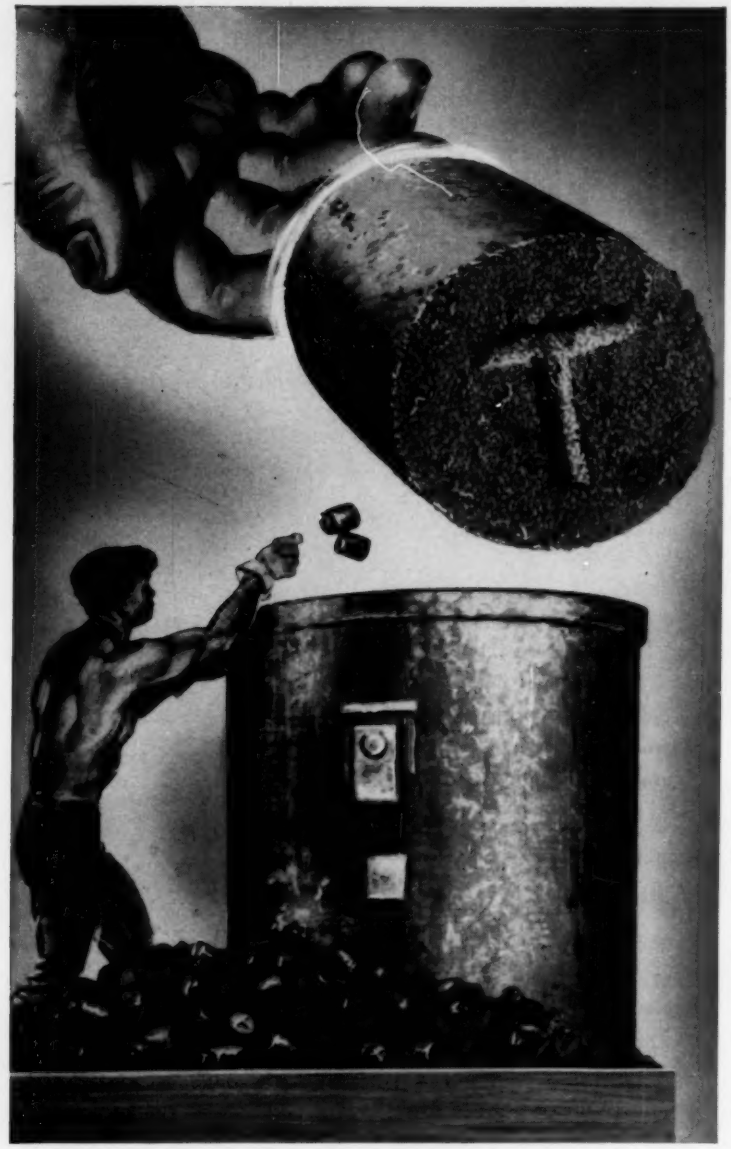
about Silicon and Manganese briquettes



Makes alloy control easier... more accurate

TENNESSEE'S Ferrosilicon and Ferromanganese Briquettes contain exact quantities of ferrosilicon and ferromanganese, making it easy to control accurately the alloy content of cupola charges. No weighing is necessary. Just count 'em to suit the charge and toss 'em in.

TENNESSEE also produces Ferrosilicon and Ferromanganese in lump and crushed forms... Tenn-Sil additive for molding sand... low-phosphorus and malleable pig iron... coke . . . all keys to lower costs and improved products.

Mail the coupon for complete information on these products.

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Producers of: **FUELS • METALLURGICAL PRODUCTS • TENSULATE BUILDING PRODUCTS • AROMATIC CHEMICALS • WOOD CHEMICALS • AGRICULTURAL CHEMICALS**

Talk of the Industry

BRASS AND BRONZE die and permanent mold casting production developments have not kept pace with the lower melting alloys because of need for mold steels that have superior resistance to the 1800 F—and up—temperatures in the copper-base field.

BINDER AND FINES REMOVAL from the effluent of wet sand reclamation equipment, now in pilot plant stage, can also be applied to wet dust collectors. This presages elimination of problem of sludge disposal. Solids content of water drops from several per cent to about 0.2 per cent, which makes it reusable for wet blasting, dust collection, wet sand reclamation, wet classification, and similar industrial uses.

HIGH TEMPERATURE MEASUREMENTS have been successfully made with resistance thermometers in which tungsten replaced the usual platinum. The thermometers, built by F. R. Sias, J. R. MacIntyre, and A. Hensen, Jr., General Electric Co., will operate up to about 1800 F, some 700 degrees higher than the platinum resistance thermometer will go.

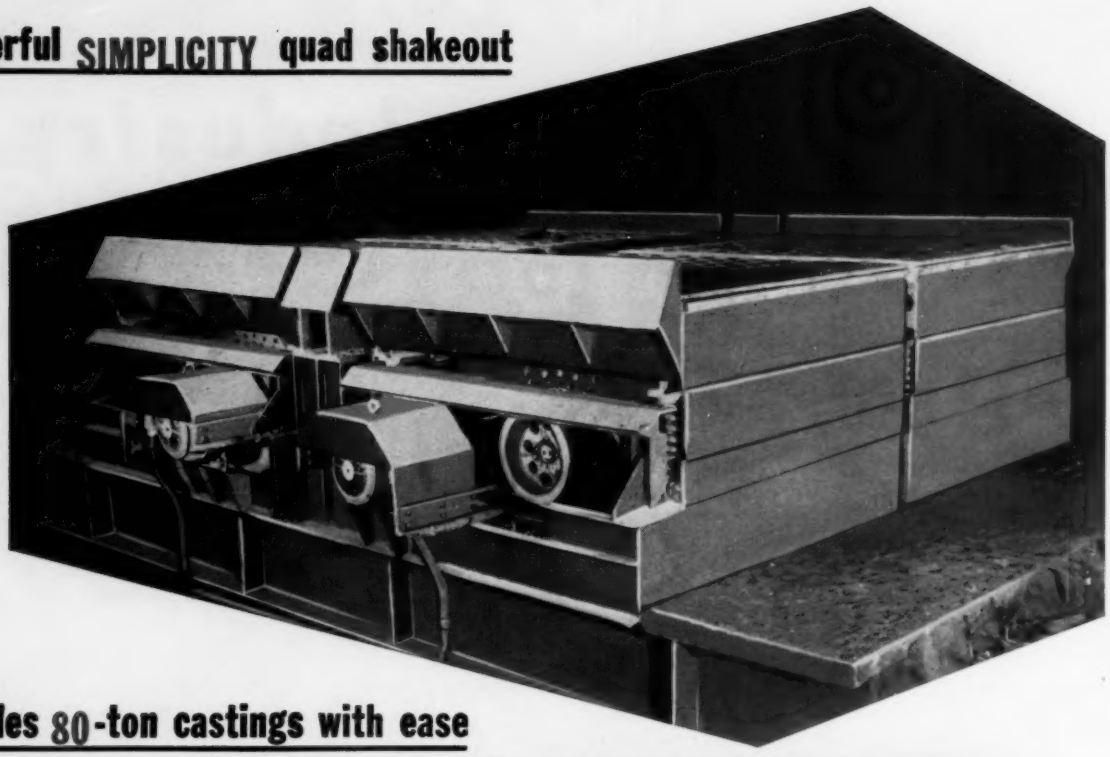
PERMANENT MOLD-CAST ALUMINUM PROPERTIES are being approached by Prof. R. W. Heine, University of Wisconsin, using green sand molds. Secret: use crushed silicon carbide instead of silica sand.

SERVICE DEPARTMENT is the name W. H. Roloff, president and general manager, Roloff Mfg. Corp., Kaukauna, Wis., gives the unskilled members of his working crew. They like the term better than such designation as "labor gang" and consider themselves available to all departments. Members of the Service Department are assigned as required to one or more departments for specified periods on any given day. Result is efficient use of manpower and expeditious handling of production problems.

EVERYTHING NEEDED for an industrial show will exist in Chicago when the proposed convention and exhibit hall is completed, Wm. W. Maloney, AFS Secretary-Treasurer, told the annual meeting of the Chicago Convention Bureau recently. He said no city now can fulfill AFS requirements for a large, well-equipped, expertly managed, and conveniently located hall, with enough hotel rooms available, and industrial plants in which exhibitors' machinery can be shown in actual use.

A CONTINUING HIGH LEVEL of scientific and industrial research is necessary to maintain the nation's economy in a position commensurate with expanding population pressures. Much of the industrial effort during the past decade has been devoted to defense research, with resulting "classification" of information. Adjustment to a non-wartime operation demands return to the spirit of free inquiry that has characterized scientific achievement. Trend toward accelerated research is evident in primary metal industries, which, in 1951, spent $34.5 million for such projects, out of national total for all industries of $1.8 billion. Although most of expenditure was by companies employing over 500 persons, smaller firms are becoming increasingly research-conscious.

Powerful SIMPLICITY quad shakeout



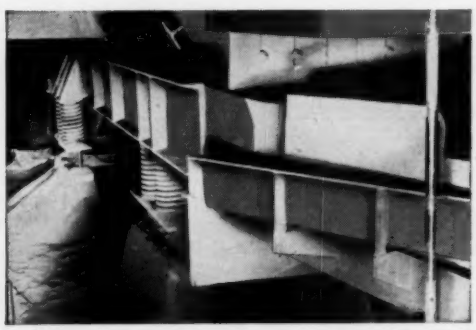
handles 80-ton castings with ease

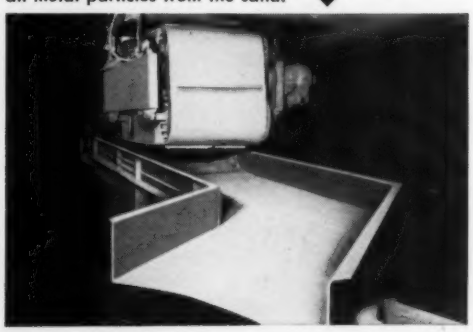
This is the Simplicity spring-mounted quad shakeout, made up of four 7′ x 8′ steel-decked Simplicity Model OM units, that is handling huge 80-ton tank hull castings for a well-known foundry.

After plenty of pounding by the big 80-ton castings, the deck of the Simplicity unit is still in sound condition. Controlled vertical vibration, concentrated at the deck, eliminates travel of flasks and castings and does a more thorough shakeout job in less time.

In the same foundry, a 4′ x 20′ Model OA Simplicity Feeder, installed under a hopper beneath the shakeout, feeds sand to the return conveyor for reclaiming without hang-up or bridging in the hopper.

This 3′ x 20′ Simplicity Model VS Conveyor, connected to the Simplicity Feeder, insures the smooth, even flow of sand back to the reclaiming unit. It is equipped with a Dings self-cleaning magnetic separator that removes all metal particles from the sand.





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Sales representatives in all parts of the U.S.A.
FOR CANADA: Canadian Bridge Engineering Company Ltd., Walkerville, Ontario
FOR EXPORT: Brown and Sites, 50 Church Street, New York 7, N. Y.

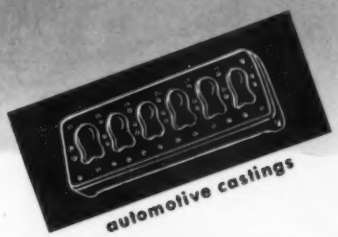
Simplicity
TRADE MARK REGISTERED
ENGINEERING COMPANY • DURAND, MICHIGAN

New 4 way BREAKOFF NICK

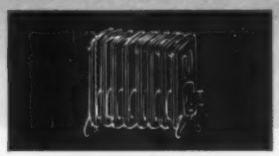
on fine FANNER shoulder radiator chaplets

saves *time* and *money*...improves castings

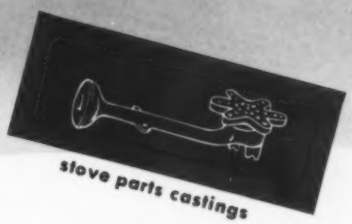
IDEALLY SUITABLE FOR



automotive castings



radiator castings



stove parts castings

EXCLUSIVE *New* 4-WAY BREAKOFF NICK

Provides maximum support during pouring, yet stem breaks off easily in any direction so that few remaining after shake-out can be easily brushed off with no apparent surface marks remaining.

STAGGERED KNITTING NICKS

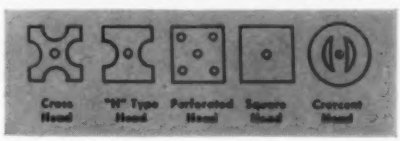
Provide better type of surface for knitting with molten metal, assuring thorough fusion and resulting in clean, solid castings.

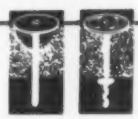
A small change in design can often result in large savings in production. The new 4-way breakoff nick on fine FANNER Shoulder Radiator Chaplets is a typical example of the constant study given to casting methods by FANNER engineers. This small but highly important feature, in addition to the other exclusive advantages offered by FANNER Radiator Chaplets, speeds the production of clean, sound castings...help cut labor costs.

Fine FANNER Radiator Chaplets are especially suitable for light pressure castings such as gas burners, radiator sections and manifolds. Designed for use with the side of largest bearing area against green sand, they will support approximately 5 pounds per square inch load.

Get complete information on fine FANNER chaplets for all requirements by writing for FANNER Chaplet catalog today!

OTHER TYPES OF FINE FANNER SHOULDER RADIATOR CHAPLETS





NO HAND TUCKING

The special FANNER "open head" eliminates need for hand "tucking" and permits jolt and squeezer machines to pack sand solidly (as shown) along *entire* stem.

STURDY SHOULDER AND SOLID RIVETED HEAD

Shoulder is designed and placed to permit chaplet to be set into pattern required distance without guesswork. Solid riveted head exactly at right angles to stem to insure that chaplet is always perfectly "true".

THE FANNER MANUFACTURING CO.

Designers and Manufacturers of Fine Fanner Chaplets and Chills

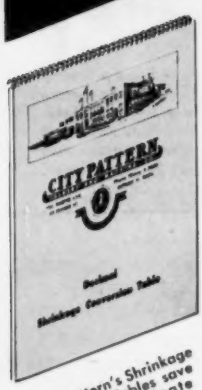
BROOKSIDE PARK CLEVELAND 9, OHIO

THE LATEST METHODS FOR THE FINEST PATTERNS

Shown above is the woodworking shop at City Pattern where the crafting of accurate master patterns is a thoroughly efficient procedure. Here you find men who know every phase of pattern making and have practiced it to its finest skill. The latest lighting techniques promote painstaking accuracy without undue eye strain . . . an accoustical ceiling deadens noise for careful concentration without fatigue . . . the latest woodworking equipment assures maximum economy in every step of the procedure.

These are but a few of the reasons why leading manufacturers rely on City Pattern for the utmost in accuracy, economy and production utility in wood and metal patterns.

SETTING THE PATTERN IN PATTERNS



City Pattern's Shrinkage Conversion Tables save time and eliminate errors in shrinkage calculations. Your letterhead request will bring one without obligation.

CITY PATTERN
FOUNDRY AND MACHINE CO.

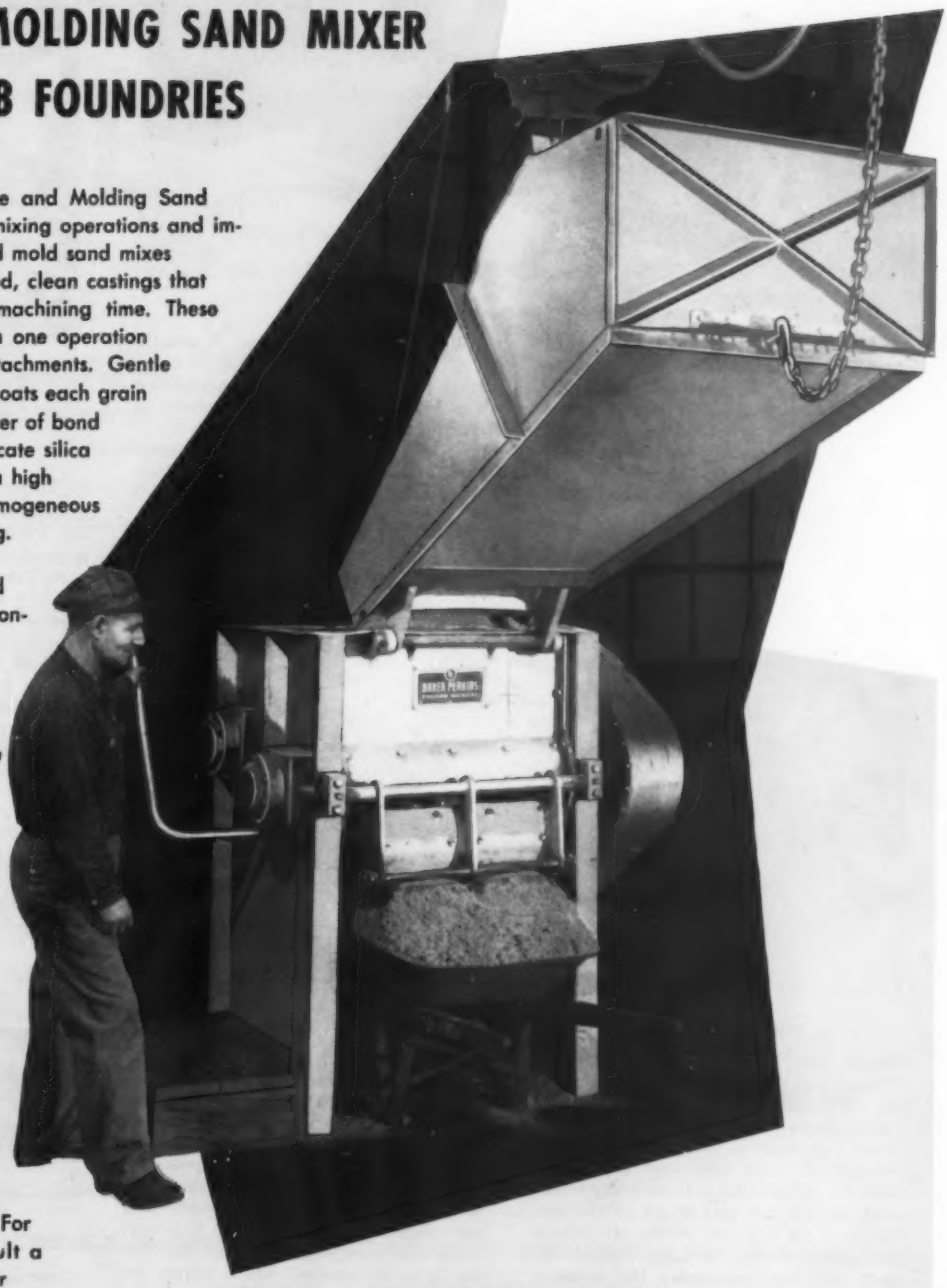
1161 HARPER AVENUE
DETROIT 11, MICHIGAN

BAKER PERKINS SIZE 14

BATCH TYPE UNIDOR CORE AND MOLDING SAND MIXER FOR JOB FOUNDRIES

BAKER PERKINS Unidor Core and Molding Sand Mixers help speed up sand mixing operations and improve the quality of core and mold sand mixes so that you can produce good, clean castings that require less shakeout and machining time. These mixers rub, stir and knead in one operation without special aerating attachments. Gentle and thorough mixing action coats each grain of sand evenly with a thin layer of bond without breaking up the delicate silica grains. The mixed sand has a high degree of permeability, is homogeneous and does not require riddling.

BAKER PERKINS Unidor Sand Mixers are strong and well constructed with a simplified operating mechanism that helps keep maintenance and operating costs low. The No. 14 Mixer shown here has a fabricated steel trough shell and cast iron ends, renewable steel liners, and cast steel Sigma blades with renewable wearing shoes of hardened steel. It has a working capacity of 5.5 cu. ft. BAKER PERKINS Unidor Mixers are available for job foundries in capacities up to 35 cu. ft. These models can be adapted to or equipped with air or electrically operated skip hoists. A laboratory model with a working capacity of 1500 to 2000 grams is also available. For complete information, consult a BAKER PERKINS sales engineer or write us today.



BAKER PERKINS INC.

CHEMICAL MACHINERY DIVISION

SAGINAW, MICHIGAN

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Products and Processes

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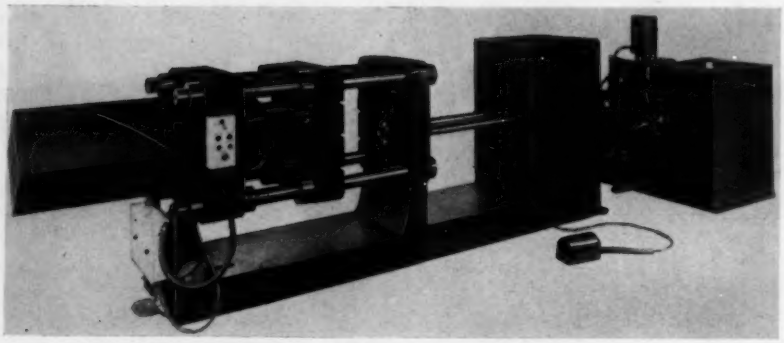
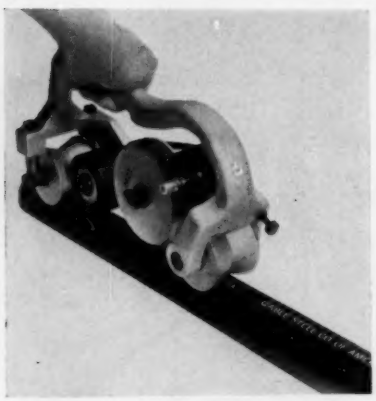


Cold Chamber Die Casting Machine

Model HD-303, heavy duty cold chamber casting machine, is particularly adapted to casting aluminum alloys at high speed from either single or multiple cavity dies, it is claimed. Magnesium and brass are also readily cast with the cold chamber type machine, the manufacturer states, and zinc, lead and tin may be cast after conversion to the hot chamber operation. A high pressure oil hydraulic system supplies the operating and injection power for the unit, with pressure up to 11,800 psi on the molten metal as it solidifies in the die cavity. The injection assembly and all controls are positioned to afford the operator easy, high speed operation. Model is designed for easy die changes. *Harville Mfg. Co.*

For more data, circle No. 171 on page 17



Portable Printer

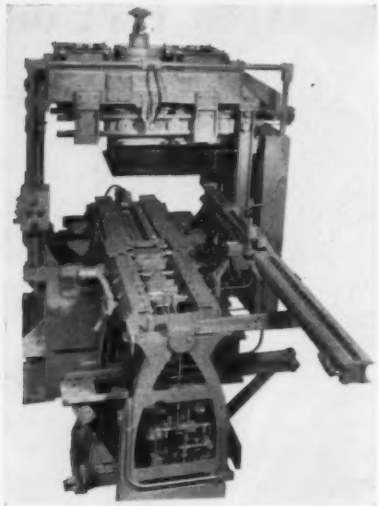
Model No. 230, Matthews Portable Printer, was developed and manufactured for continuous printing of tradenames, codes, inspection marks, etc., on flat, round, square or hexagonal surfaces. Riding on front and rear positioning rolls, the printer will automatically adjust itself to the size and shape of the material to be marked. Made of durable aluminum, printer is light enough for easy handling, permitting the operator to carry it anywhere in the plant to the location of the stock. Rubber type and type holder are designed for simplicity and quickness of type changes. *Jas. H. Matthews & Co.*

For more data, circle No. 172 on p. 17

Floor Sweeper

Utilizing a turbine principle, the Turbo-Sweep sucks dust from the air at a rate of more than 300 cfpm, while heavy-duty fiber brushes are whisking debris into a collecting hopper, thus overcoming the objections about dust-pollution of air when powered floor sweepers are used, it is claimed. The dust-collecting bag is sufficiently large (1.6 cf) to permit infrequent emptying and unit features the "control console" which places all controls within easy reach of the operator and eliminates foot pedals and kick levers. Control console contains throttle, hopper, brush height and clutch controls. *Parker Sweeper Co.*

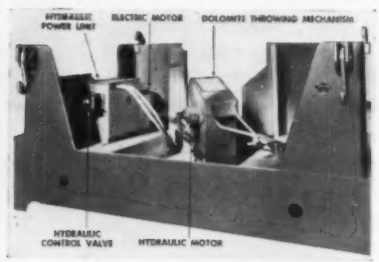
For more data, circle No. 173 on p. 17



Core Blower

Shown with the new Sutter Model SP-221 Dual-Head Automatic Core Blower is the Sutter Automatic Double Rollover Core Draw Machine with pushout device and the Sutter Automatic Transfer device which moves the cores from the blower to the draw machine. In installations of this type, it is claimed, high volume production can be achieved and at the same time more consistent core quality can be maintained since the human element is removed from the operation. Even unskilled operators can maintain peak production without any reduction from top core quality. Blower provides up to 400 blows per hour, and features two blow heads which can be used for the same or different cores. *Sutter Products Co.*

For more data, circle No. 174 on p. 17



Hydraulic Drive

Close-up of lower support of a machine with new hydraulic drive that motivates the belt which throws the dolomite into the furnace by centrifugal force. Hydraulic power unit is contained in the square tank shown. *Blaw-Knox Co.*

For more data, circle No. 175 on p. 17

the same results at lower cost with– MEXITE®

MEXITE briquettes, composed of 70% graphitic carbon, provide foundrymen with a positive method of raising and stabilizing the carbon content of cupola charges and at the same time reduce the cost. Larger amounts of scrap can be used with resultant savings in charging costs. For example, if 400 lbs. additional scrap is charged, four MEXITE briquettes will retain the same carbon analysis at a savings of $3.06* per ton of charge.

MEXITE helps produce better castings because they permit accurate carbon control. MEXITE helps assure lower chill and hardness, and provides better fluidity and machinability thus increasing useable metal yield and cutting scrap loss. MEXITE briquettes are packed 90 lbs. to a carton for easy handling and storing. We'd like to show you what MEXITE can do in your foundry . . . write us today for a specific recommendation made for your particular area. We'll also send along our newest bulletin that will show you how MEXITE can help keep your costs down where you want them to be.

** Based on average current pig iron and scrap prices*

OUR 100th YEAR 188

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

Products & Processes

For additional information,

use postcard at bottom of page 17

continued on page 17

Hydraulic Pusher

Hydraulic pusher device for use on hydraulically actuated fork trucks provides a means for mechanically pushing a load off a truck's forks and is designed principally for handling loads without pallets. Pusher unit consists of a vertical load screen guided by a pair of pantographs, one on each side. Power to extend and retract the screen is supplied by a telescoping, double-acting hydraulic cylinder acting through specially located thrust arms. *Elwell-Parker Electric Co.*

For more data, circle No. 176 on p. 17

Welding Goggle

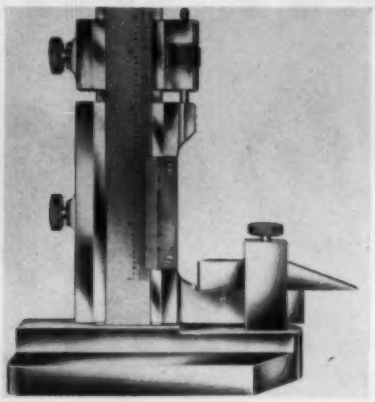
"Stac-Vent" goggle for welding combines greater comfort with lower cost protection. Provides draft ventilation at the top and center of the goggle where warm, moist air normally accumulates. *Watchemoket Optical Co.*

For more data, circle No. 177 on p. 17

Plastic Spectacles

All-plastic spectacle is designed to permit change from regular to side shield model. Perforated acetate side shields screw into place for jobs requiring side protection. *United States Safety Service Co.*

For more data, circle No. 178 on p. 17



Height Gauge

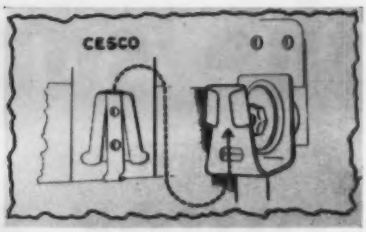
Satin-finish stainless steel height gauge features chrome-plated graduations. Graduations and figures stand out clearly against the dull chrome background, making them easier to read, it is claimed. Chrome-plated gage has a completely hardened beam and the 1.255 in. adjustable vernier is also made of chrome-plated stainless steel. *Foster Supplies Co.*

For more data, circle No. 179 on p. 17

Adjustable Bar Hanger

An adjustable bar hanger that meets every requirement and passes every test, according to the manufacturer, has a special shape that adds tremendous strength to the hanger. Adjustment is obtained by a telescoping action of the two halves of the hanger similar to the action of an adjustable curtain rod. Another advantage is the Raco Clip which secures the box to the bar without interfering with device space in the box. It also provides added wiring room in multiple device boxes, it is claimed. Bars are available in two styles, clip bars and stud bars. Each bar comes in two sizes. *Raco Div., All-Steel Equipment, Inc.*

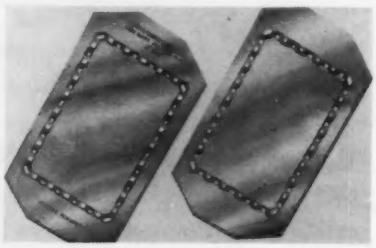
For more data, circle No. 180 on p. 17



Mounting Device

New mounting device, consisting of wedge shaped brackets which slide together and lock securely, and which may be as quickly unlocked, permits combinations of a head gear and helmet, or plastic shield, or wire screen shield; or hard hat with the same protective equipment. A tilting mechanism allows the user to raise or lower the helmet or shield without difficulty, and an easily adjusted tension spring compensates for the difference in weight of the different pieces, it is claimed. *Chicago Eye Shield Co.*

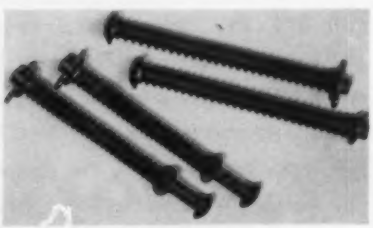
For more data, circle No. 181 on p. 17



Pattern Plate

Shifts are reduced to a minimum, it is claimed, with Gefscorp "Non Shift" aluminum pattern plate. Other features claimed for the plate is that it prevents runouts; it is designed to give automatic and positive sand to sand lock around the entire perimeter of the mold, and no cores, mold anchors or steel balls are needed. *General Foundry Service Corp.*

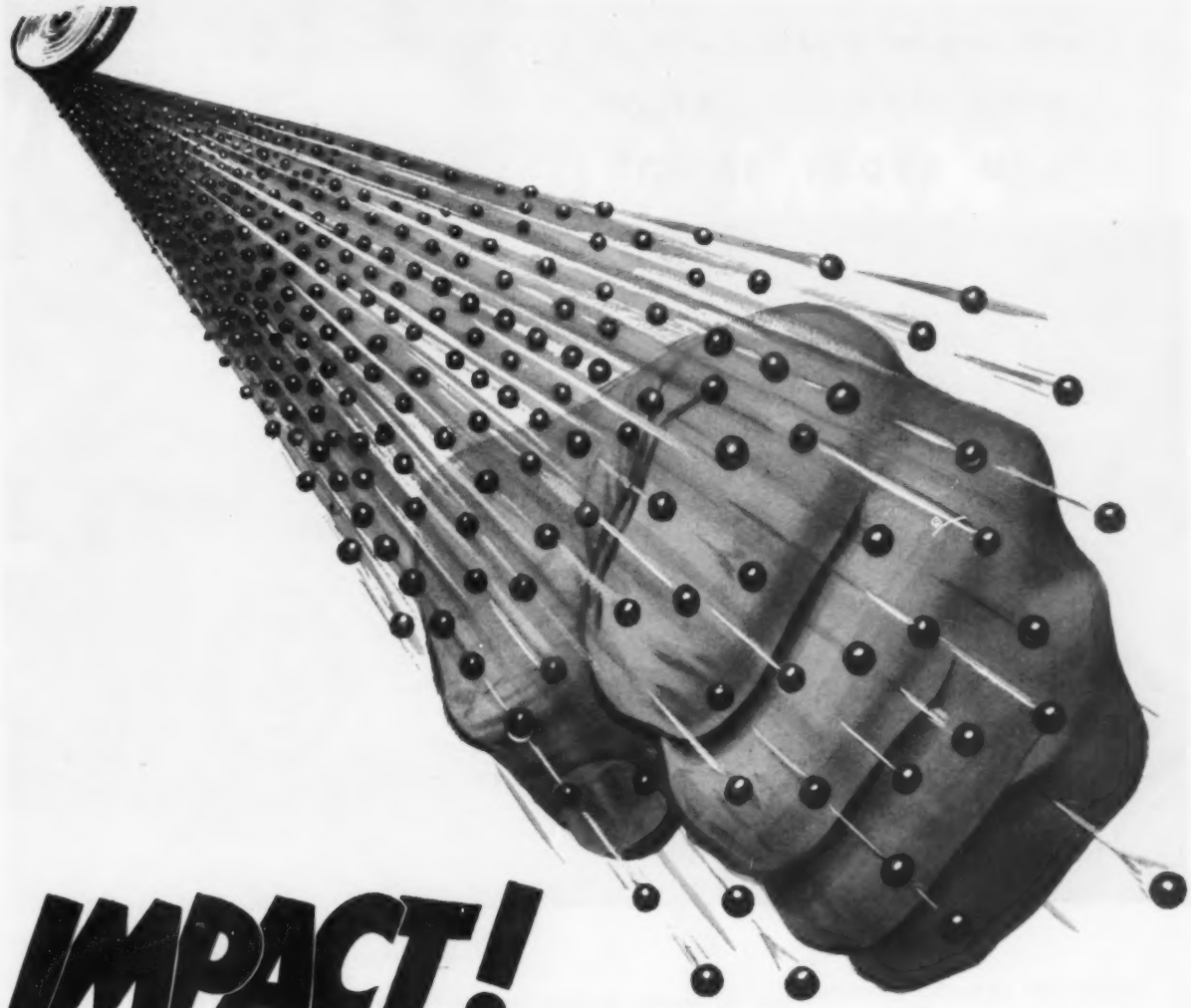
For more data, circle No. 182 on p. 17



Ejector Pins

Manufacturer has developed a standard Ejector Pin assembly which meets all the specific needs of the shell mold process. D-M-E Standard Ejector Pins are ⅜ in. in diameter and at the present time are available in standard lengths of 6 in. and 7½ in. Pin embodies the "mushroom" head design and also incorporates a negative angle under the head to give a positive seal and prevents the investment material from seeping under the head during the molding cycle. Pins are heat-treated to reduce wear. *Detroit Mold Engineering Co.*

For more data, circle No. 183 on p. 17



IMPACT!

MALLEABRASIVE . . . SHOT OR GRIT . . . is *packed* with blast cleaning power for profitable operation.

Because Malleabrasive is scientifically heat-treated and laboratory-controlled it does a *better, faster* cleaning job. And because it cleans quicker, lasts longer, saves you parts repairs and downtime—Malleabrasive means *cheaper cleaning.*

Words won't prove it—the final test is in *your* equipment. Try Malleabrasive on your jobs and see for yourself. Next time you order blast cleaning abrasive, specify Malleabrasive from PANGBORN CORP., 1300 Pangborn Blvd., Hagerstown, Md.

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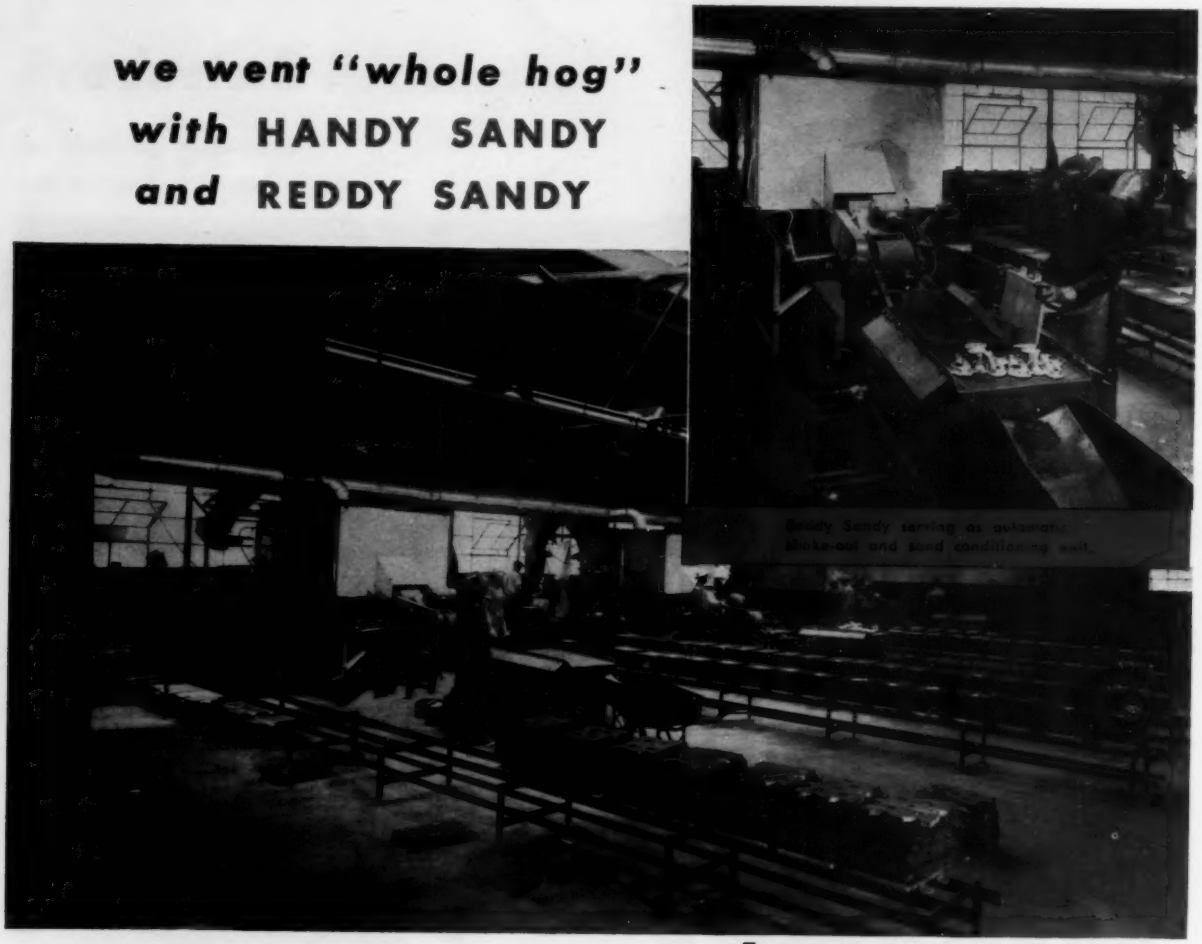
PANGBORN'S 50th ANNIVERSARY—1904-1954

*U. S. Patent # 2184926
(other patents pending)

we went "whole hog" with HANDY SANDY and REDDY SANDY



Showing how 3 Handy Sandys and Reddy Sandys have simplified molding and set-out operations.

...and it paid off

"When our foundry was improved recently, we did not stop at halfway measures," states Mr. Elmer E. Lundquist of the Lake City Foundry Co., Chicago, Illinois. "Newaygo equipment looked so good to us that we decided to take full advantage of the obvious time, labor and cost saving features.

"Previous to remodeling, our molding machines were on one side of the shop and the bench molders on the other, with two sets of overhead cranes running the length of the shop. Pouring crucibles were picked up by either right or left hand cranes and brought to the molds. Now, all three Handy Sandy's and Reddy Sandy's as well as the bench molders are on one side of the shop, and one 'overall' crane takes the metal to any place in the foundry without any transfer procedure.

"The molders no longer have to carry each complete squeezer mold to its pouring location. Now, he simply turns around and places the mold on the rails and rolls it down the length of the set-out. Naturally, the molders are very pleased with the new sand handling arrangement. They expend less energy per mold and without carrying molds down to pouring locations, they have increased their output at least 20% over previous methods."

The Lake City Foundry Co., Inc. was founded in 1920 by Karl Lundquist, a foundryman since the age of 12. The original foundry, producing mainly jobbing and intricate pattern castings, grew under his capable guidance. In 1930 he was joined by his son Arnold and in 1942 when Karl retired, another son, Elmer, joined the foundry.

In 1946 the present modern plant at 2324 West Fulton Street was put into operation for the volume production of aluminum, bronze and copper castings. The Lundquists have always maintained high quality castings with each job getting their personal attention.

Mr. E. Long is the Plant Superintendent and Mr. R. Peterson is the Foundry Engineer.

NEWAYGO engineering company
NEWAYGO, MICHIGAN

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Simple Manually Operated Permanent Molds

"Master" craftsmen take great pride in their ability to always furnish the exact mold or pattern to solve any specific casting problem . . . a pride based on a long and successful record of helping our customers cut production cost to a bare minimum.

Send your next casting problem to Master Pattern and be certain of getting the right answer quickly.

We welcome your inquiries . . .

Send blueprints or sample castings . . . now!

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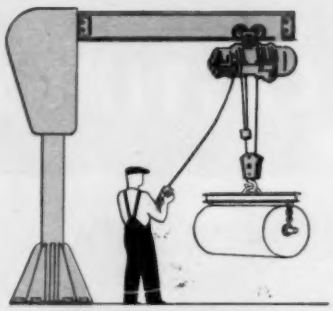
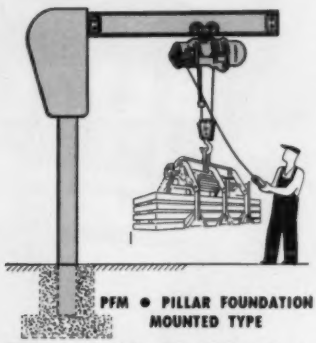
Industrial JIB CRANES

Industrial Jib Cranes are designed and built to the same high standard set for Industrial Overhead Traveling Cranes. The smooth performance and unfailing service of these quality Jib Cranes has made them favorites throughout industry. Consult Industrial Crane & Hoist Corporation for better equipment to solve your materials handling problems.



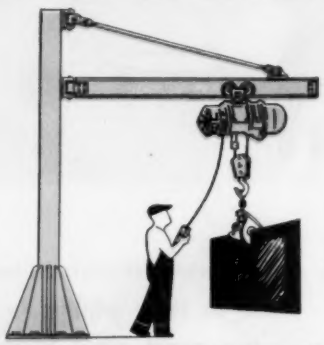
PBM • PILLAR BASE MOUNTED TYPE



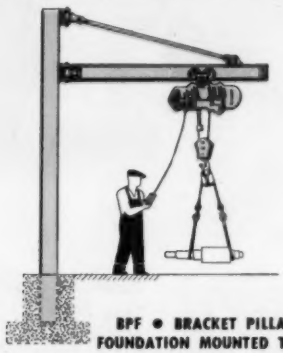
PFM • PILLAR FOUNDATION MOUNTED TYPE

The Industrial PBM and the PFM Heavy Duty Jib Cranes are the same except for the construction of the base. Self-supporting and designed to revolve in a complete circle these Jibs can be economically used in a myriad of applications. The 4 roller, 9 bearing head is designed for heavy duty applications and both models are available in capacities up to 12,000#.

The Industrial PBM and the PFM heavy duty, self-supporting Jib Cranes are designed for 360° rotation, are of welded steel construction, and equipped with ball and roller bearings. Capacities up to 12,000 #.

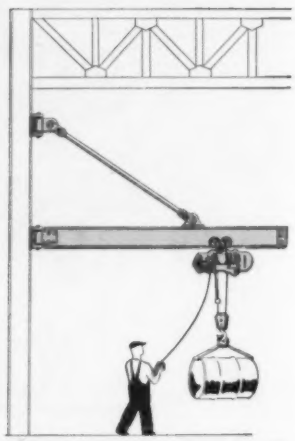


BPB • BRACKET PILLAR BASE MOUNTED TYPE

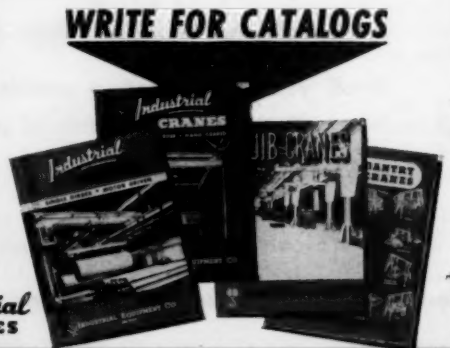


BPF • BRACKET PILLAR FOUNDATION MOUNTED TYPE

The Industrial BPB and the BPF self-supporting Jib Cranes are designed for 180° rotation. Equipped with annealed cast steel hinge fittings, heavy duty bronze bearings and double tie rods. Capacity up to 6000#.



WBT • Industrial Wall Bracket Type Jib Crane for mounting on a steel column or factory wall. Available in capacities up to 6000#.



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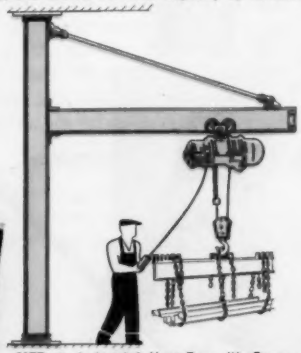
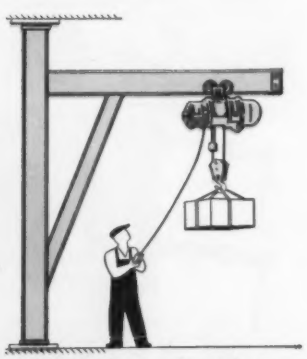


MTD • Industrial Mast Type Jib Cranes designed to rotate 360°. Equipped with heavy duty top and bottom bearings. Capacities up to 12,000#.



MTC • Industrial Mast Type Compression Brace Jib Crane, designed to rotate 360°, equipped with heavy duty top and bottom bearings. This Jib is designed for high lift in capacities up to 12,000#.

Industrial CRANES

INDUSTRIAL CRANE & HOIST CORPORATION

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Products & Processes

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Continued from page 12

CONVENIENT FORM FOR ORDERING INFORMATION

Leather Preservative

Silicone leather preservative keeps work shoes and leather equipment soft and pliable despite the deteriorating influences unavoidable in many industrial plants. Known as Shoe Saver, material is a clear fluid which may be applied with a soft cloth or swab. It is water repellent, not a waterproofing agent, and does not seal the pores, but rather coats the individual fibers, permitting treated leather to "breathe." Air is let in; water, oil and various chemicals are kept out. *Dow Corning Corp.*

For more data, circle No. 184 on card

Belt Sander

Multi-Shape Belt Sander using only one rotating drum, the opposite end of the belt sliding over changeable small radius shaped tips features multi-position design, chassis rotates in 90° arc; three speeds through use of V belt pulleys, and heavy duty all welded design. It is used on metals, plastics, wood, glass, leather and stone; and is used for flat, round, and irregular shapes of all kinds. *Von Jonker Corp.*

For more data, circle No. 185 on card

Conveyor Chain

Versatility of Acmor Hollow Pin Chain makes it adaptable for construction of automation units. Almost any attachment work may require can be added onto the chain, it is claimed, making it unnecessary to order chain with special attachments. Chain can be stocked in various pitches—it is made in pitches from 2 in. to 6 in.—and attachments can also be stocked to suit individual requirements. *Acmor Conveyor Chain Co.*

For more data, circle No. 186 on card

Wheel Dresser

Three new model wheel dressers offer a variety of features and work capacities. Model A, with a 3.400 center height, can be used to dress any angle tangent to a radius, concave or convex, in any precision grinding wheel. A reported advantage is that it permits dressing at the base of the wheel, or point of contact. Model B, 2.600 center height, is designed to fit smaller surface grinders. It is claimed that it will dress a radius and any two tangent angles in one operation. Model C incorporates a tilting feature which is designed to compensate for compound angles involved in grinding form tools. *Last Word Sales Co.*

For more data, circle No. 187 on card

Lubricating Grease

Castorine Tena-Film grease is a radical deviation from the conventional greases, according to the manufacturer, because there are no soap ingredients whatsoever in the product and its chemical processing is a new science in grease making. Outstanding feature claimed is the long service life of the grease, made possible due to its unbreakable structure, extreme high and low temperature properties and its adherence to all metals. *Baum's Castorine Co., Inc.*

For more data, circle No. 188 on card

Jet Blast Cleaning

New bench model Jet Blast cleaning equipment eliminates costly hand operations from metal cleaning routine, manufacturer claims. Unit has 24 in. diameter, is 43 in. high and weighs only 155 lb. Because of its compactness and relatively light weight, it is portable and can be moved easily from one job location to another. One or two blast guns may be used. Liquid capacity is two gallons and the abrasive capacity is 13 lb. Motor for the blower operation is 1/10 hp, 110 Volts, 60 cycle single phase. Availability of this new unit now puts up-to-date method of metal cleaning within the reach of small metal working shops, it is pointed out. *R. W. Renton and Company.*

For more data, circle No. 189 on card

Reader Service Dept.

54|4

Please send me detailed information on the Products and Processes.

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Free Foundry Information

For additional information use postcard at bottom of this page

Melting Furnaces

Bulletin No. 29 describes Simplex Melting Furnaces. Contained in the bulletin are photographs of the furnaces as well as specifications, diagrams, performance and other technical data. *Lindberg Engineering Co.*

For more data, circle No. 190 on card

Pressure Tightness

Bulletin No. 43, "Meehanite Castings for Pressure Tightness," contains 64 illustrations of specific industrial applications of Meehanite castings where specifications demanded absolute density, uniformity and resistance to various pressure ranges. Also provides some engineering property charts and pressure casting design suggestions. *Meehanite Metal Corp.*

For more data, circle No. 191 on card

Cupola Gases

Bulletin FO-9, "Review of Foundry-Cupola Gases and Temperatures," is designed to help foundrymen understand many of the troubles encountered from "low beds" and "oxidized iron." It is supported by graphic presentations and complete analyses which supplement original contributions made by A. W. Belden, foundry engineer, to knowledge of gas compositions and temperature distribution in cupola melting zones. *Whiting Corp.*

For more data, circle No. 192 on card

Electric Vibrators

Catalog No. 10 contains factual and technical data on new line of vibrators known as Model RC Cleveland and Model MC. An engineering data sheet is enclosed which can be filled out and returned for advice on vibration problems. Brochure also contains a price list of both models. *Cleveland Vibrator Co.*

For more data, circle No. 193 on card

Dust Collector

Bulletin No. 916 describes the Unit-Type CN cloth bag dust collector. It points out how dust control for all types of finely divided dry dusts can be provided for smaller volume applications. Detailed descriptions of the dust collector operation and the cloth bag sealing mechanisms are presented. Also included, are the construction and assembly features of each dust collector. *Pangborn Corp.*

For more data, circle No. 194 on card

Core Paste

Product Bulletin No. F-201 refers to the development of Stevens Korfast Core Paste. Greater tensile strength, lower gas evolution, better "green grab" and faster drying are some of the features claimed in the bulletin. Results of comparison tests made in the laboratory are listed. *Frederic B. Stevens, Inc.*

For more data, circle No. 195 on card

Abrasives

Catalog No. 1153 tells how to select the proper abrasive for individual needs. It also explains the shot peening and abrasive impact cleaning processes. An abrasive consumption chart lists the various abrasives and gives their consumption rate in pounds per wheel hour. Complete and detailed SAE Specification charts are also presented. *Cleveland Metal Abrasive Co.*

For more data, circle No. 196 on card

Refractories

A 16-page catalog includes data on development, physical properties and advantages of "Shamva" super-refractories, in addition to illustrations and descriptions of typical installations. Separate sections give complete details and uses of ramming mixes, mortars, patching mixes, castables, plastic mixes and special refractory products. Reference chart gives specifications on all mixes for grain size, weight, method of shipping and installing and standard packaging. *Mullite Refractories Co.*

For more data, circle No. 197 on card

continued on page 100

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COLEMAN OVENS

reduce waste . . . lower costs

in every type of foundry

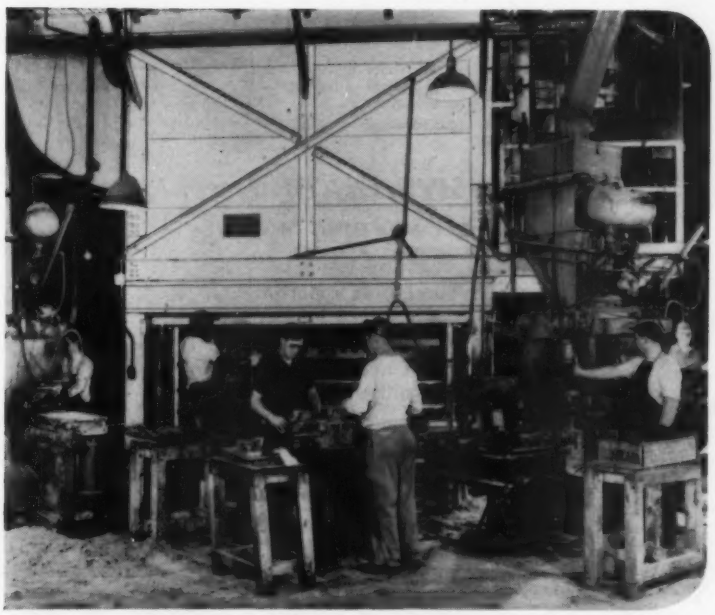
You can reduce casting scrap . . . cut your labor, material and fuel costs by baking cores and drying molds in Coleman Ovens. Small and large foundries alike find that Coleman Ovens are vital to better quality castings and increased profits.

Coleman Ovens quickly pay for themselves out of direct savings in labor, materials and reduced casting scrap.

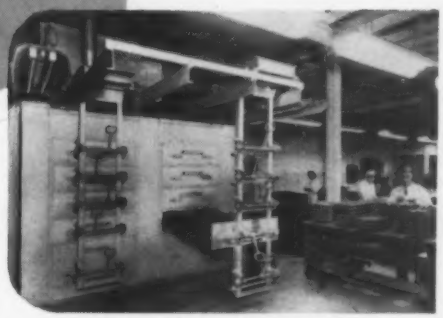
Coleman Engineers have pioneered and developed the most efficient oven designs to meet the highly specialized needs of modern foundry methods in all classes of work — grey iron, malleable, steel, alloy, brass, aluminum and magnesium.

Profit by this experience — let us recommend, at no obligation, the Coleman Oven for your needs.

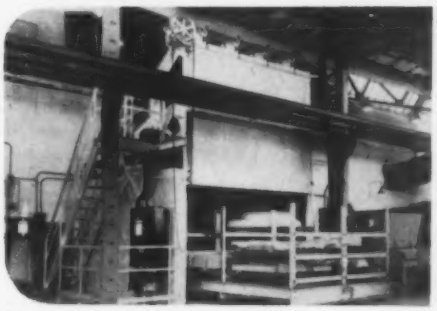
Write for Bulletin E



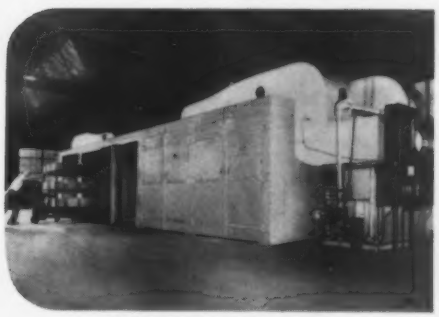
Coleman Tower® Oven in Automotive Foundry



Coleman Rolling Drawer Ovens in Brass Fittings Foundry



Coleman Car-Type Oven in Steel Foundry



Coleman Transrack Ovens in Pressure Pipe Foundry

A COMPLETE RANGE OF TYPES AND SIZES

for every core baking and mold drying requirement:

Tower Ovens • Horizontal Conveyor Ovens
Car-Type Core Ovens • Car-Type Mold Ovens
Transrack Ovens • Rolling Drawer Ovens
Portable Core Ovens • Portable Mold Dryers

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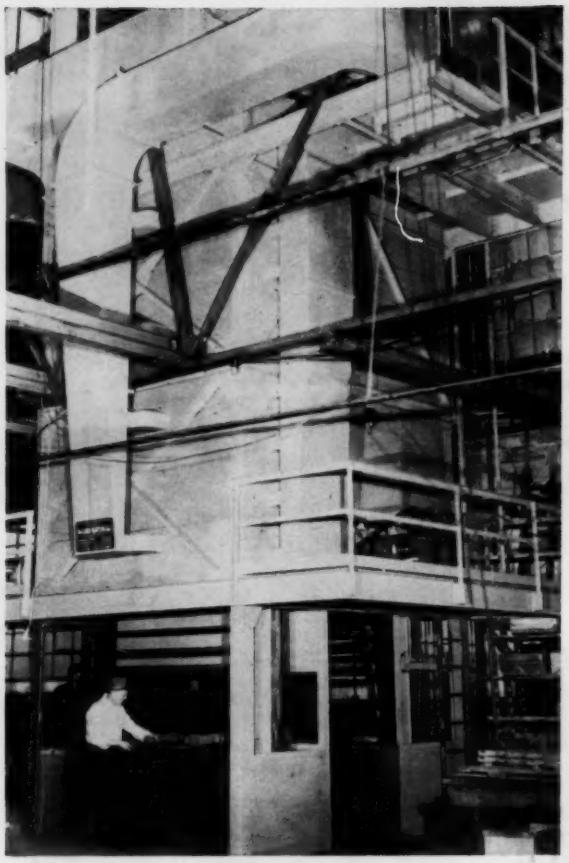
1825 COLUMBUS ROAD **CLEVELAND 13, OHIO**

WORLD'S OLDEST AND LARGEST FOUNDRY OVEN SPECIALISTS

CARL-MAYER

Important Development in VERTICAL CORE OVENS



HEAT FAN INSIDE OF OVEN ←

Recent installation of Carl-Mayer Vertical Core Oven with combination gas and oil fired recirculating heating system, at G. & C. Foundry Co., Sandusky, Ohio.

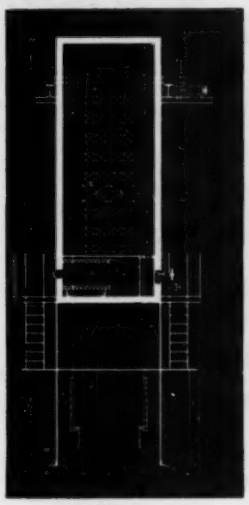


Fig. 1
NEW METHOD with heat fan inside oven. Patent No. 2,628,087.

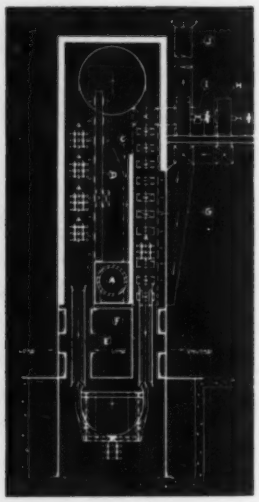


Fig. 2
Section showing conveyor travel thru pass, heating, cooling and exhaust system.

Vertical Ovens (Figs. 1 and 2) are by Carl-Mayer, using the universally adopted recirculating heating system with sealed combustion chamber located between the conveyor chains (Patent No. 2,257,180) and new method heat fan inside of oven (Patent No. 2,628,087).

EXCLUSIVE HEATING SYSTEM *pays off several ways!*

- Saves platform space.
- Eliminates external heat duct, reducing heat losses.
- Placing heat fan *in* oven also reduces heat losses, resulting in high operating efficiency.
- By eliminating external heat duct and fan insulation, it reduces installation cost.
- There is no smoke as from external heat ducts.
- Oven appearance is greatly improved.

Other important features contribute to faster baking, lower fuel consumption, smaller core losses, safer operation, elimination of smoke, cooled cores at unloading position and reduced labor cost.

A few of our Vertical Oven Customers:

Aluminum Co. of America
Ashland Malleable Iron Co.
Buick Motor Div. of General Motors Corp.
Cadillac Motor Div. of General Motors Corp.
Chevrolet Motor Div. of General Motors Corp.
Electric Autolite Co.
Ford Motor Co.
Fremont Foundry Co.
G. & C. Foundry Co.
General Steel Castings Co.
Ingersoll Steel & Disc Div. Borg-Warner Corp.
Richmond Radiator Co.
H. B. Salter Co.
Union Brass & Metal Mfg. Co.
West Michigan Steel Castings Co.
A. C. Williams Co.

Write for Bulletins No. 53-CM and HT-53

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Visit us in Booth 1807 during AFS Foundry Show

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- EXPORT DEPARTMENT: 731 Strand, London

SITUATION UNDER CONTROL

BY KEOKUK

CHIEF KEOKUK:

"Ugh! Heap smart little chief. I say, Rub sticks to start fire. Him rub MATCH sticks!"

PRINCESS WENATCHEE:

"Yes, Junior has <u>everything</u> under control!"

KEOKUK ELECTRO-METAL COMPANY

KEOKUK, IOWA

WENATCHEE DIVISION, WENATCHEE, WASHINGTON

Keokuk Silvery . . . the superior form of silicon introduction for steel plants and foundries . . . available in 60 and 30 lb. pigs and 12½ lb. piglets . . . in regular or alloy analysis. Keokuk also manufactures high silicon metal.

There's just no match for Keokuk Silvery Pig Iron to control quality and costs. *Due to its exact, uniform analysis, Keokuk assures less waste resulting in greater economy.* Car for car, pig for pig, its uniformity *never* varies. Charge Keokuk by magnet or count!

SALES AGENT: MILLER AND COMPANY

332 S. Michigan Ave., Chicago 4, Illinois
3504 Carew Tower, Cincinnati 2, Ohio
407 N. Eighth St., St. Louis 1, Missouri

This metal will be
ROCKED and SPUN
to make a better casting

Detroit Electric Furnaces melt both ferrous and nonferrous alloys at Shenango's Centrifugal Casting Division, Dover, Ohio.

Six Detroit Rocking Electric Furnaces melt alloys for huge centrifugally cast sleeves, rings and fabric rolls at Shenango-Penn Mold Company. These fast melting Detroit Furnaces achieve the close control of temperature and metal analysis required, producing better centrifugal castings with fewer rejects.

Indirect arc melting and controlled rocking action produce finer, more uniform melt results. Electrodes are always clear of the molten metal, holding alloy variation and carbon pickup to a minimum. Rocking action assures homogeniety of the metal and washes it over more refractory surface for greater heat utilization, longer refractory life.

The versatile Detroit Rocking Electric Furnace melts ferrous or nonferrous metals with speed and economy. Send us your melting requirements and our engineers will show you how "Detroit's" can do a better melting job for you. Write today!

DETROIT ELECTRIC FURNACE DIVISION

Kuhlman Electric Company • Bay City, Michigan

Foreign Representatives: in BRAZIL—Equipamentos Industrias, "Elsa" Ltd., Sao Paulo; CHILE, ARGENTINA, PERU and VENEZUELA: M. Castellvi Inc., 150 Broadway, New York 7, N. Y.; MEXICO: Cia Proveedora de Industrias, Atenas 32-13, Apartado 27A3, Mexico 6, D. F., Mexico; EUROPE, ENGLAND: Birlec, Ltd., Birmingham.

Letters to the Editor

All letters of broad interest which do not violate AFS policy or good taste are publishable. Write to Editor, American Foundryman, 616 S. Michigan Ave., Chicago 5, Ill. Letters must be signed but will be published anonymously on request.

Measurable in Money

Being a former Hoosier gray iron foundryman and cupola operator, I was very pleased to see the article in the February issue of AMERICAN FOUNDRYMAN which gave a brief rundown of Sam Hodler's operation in Columbus, Ind.

I, too, in the past, visited Sam, observed his operation, and came away with some of his ideas, which I incorporated in my own cupola. The results I obtained were definitely measurable in dollars and cents through savings in coke, alloy and misrun castings.

R. SPURGIN
Asst. Sales Mgr.
National Engineering Co.

Confusion

Did your inquirer on page 68 of the December issue perhaps get the order of his words confused? He may have meant a plastic clay lined graphite crucible and not a plastic lined clay graphite crucible.

H. A. SCHWARTZ
National Malleable &
Steel Castings Co.

Wants Tearsheets

Please send tear sheets of reprints of "Work Simplification Saves $300,000 in Six Years," and "Practical Maintenance Hints for Reduction of Rubber Belt Wear," which appeared in the February 1954 issue. . . .

JOHN O'MEARA
Foundry Engineer
Banner Iron Works

Ask Data on Refractory Molds

The following article appeared in the February 1954 AMERICAN FOUNDRYMAN, Talk of the Industry page:

REFRACTORY MOLDS that are poured as a slurry over hard plaster patterns, then suddenly gel to rubbery consistency ready for ignition are the key to a new British casting process. Present applications involve casting of all types of alloys including those difficult to machine. Castings are reported to be produced with a fine, "die-cast" finish consistently to limits of 0.005 in. Largest casting to date is steel, weighs 35 lb. Possibly already cast is one weighing 130 lb. Major drawback at present is high cost of mold material, representing 75 per cent of the cost of materials and labor.

Do you know anything more about this? Can you supply us with additional information? Would appreciate whatever info you can send.

H. H. HARRIS
Alloy Engineering &
Casting Co.

Under the heading "Talk of the Industry" on page 5 of the February issue, reference is made to a new British casting process involving quick setting refractory molds. We are interested in further information and would appreciate your making available to us the names and addresses of the parties we should contact.

J. H. RAUCH
Roll Superintendent
Aetna-Standard Engineering Co.

(Details on the Osborn-Shaw process can be obtained by writing Shaw Processes, Ltd., 25 Clyde Vale, Dartmouth Road, Forest Hill, S. E. 23, England. An article describing current use of the process in a British foundry will appear in the June issue of AMERICAN FOUNDRYMAN.*)*

Enjoys the Magazine

Thank you for the January issue of AMERICAN FOUNDRYMAN, which I have just received in Rome. This is the most interesting book I receive, and I'm looking forward to getting it each month I'm over here.

One of the biggest jobs is to convince foundrymen here, as well as all over Europe, that they can make much more of their work in green rather than dry sand if they will only control their sand. They say they don't have the sand the United States has, but I have proved that they do. It is the mixtures they don't have and there is room for a great deal of experimenting with modern sand mixtures.

It is amazing how few people know of the value and importance of the foundry in everyday life . . . I honestly feel we are too bashful and don't let people know how much they depend on us . . . I am making a foundry film in Italy to show how much depends on the foundry.

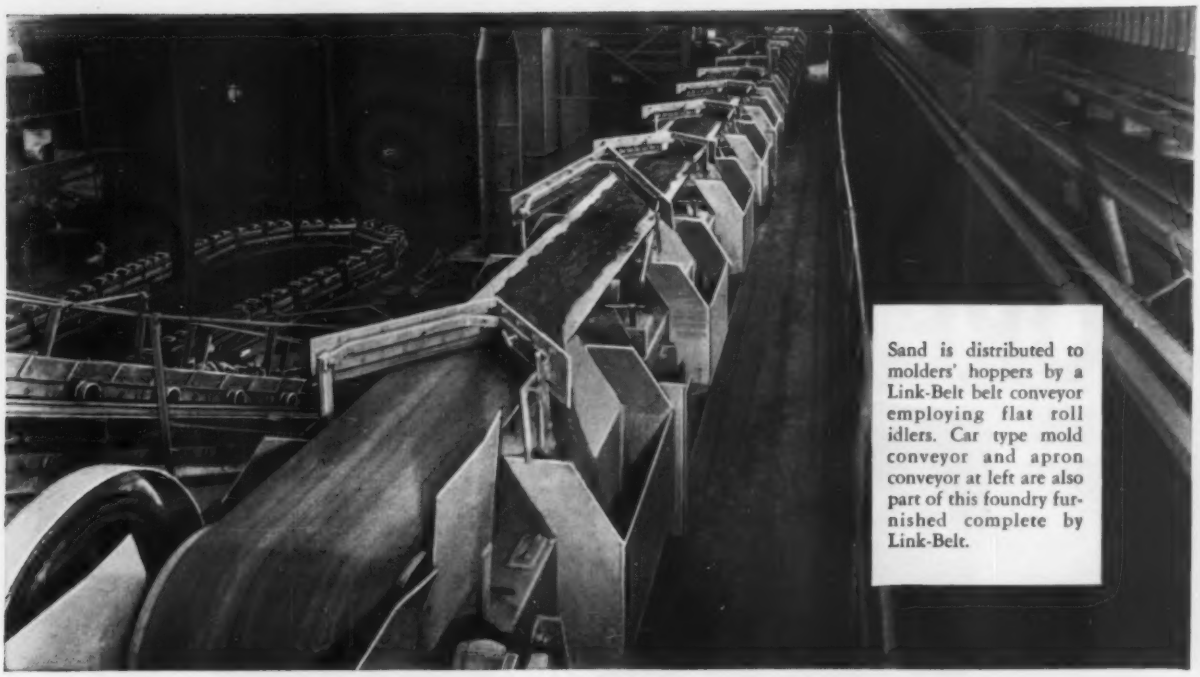
JOE PRENDERGAST
Foundry Specialist
-Operations Mission to Italy

Aluminum Assn. Meets

The Aluminum Association held its annual meeting in New York, January 19-21. D A. Rhoades, Kaiser Aluminum & Chemical Corp., Oakland, Calif., was re-elected president for the year. Arthur V. Davis, Aluminum Co. of America, New York, was re-elected chairman of the board; and Donald M. White was re-appointed secrteary and treasurer.

The Association's four active commodity divisions held sessions and elected officers during the three-day sessions. In the Foundry division, R. G. Tessendorf, Aluminum Industries, Inc., Cincinnati, was elected chairman; and J. Frank Seeley, Bohn Aluminum & Brass Corp., Detroit, was chosen vice-chairman. E. G. Fahlman, Permoid Co., Medina, Ohio, was designated the division's representative on the board of the directors; and D. M. White was renamed treasurer.

Los Angeles area foundrymen were among the more than 500 superintendents, buyers and purchasing agents who attended a grinding symposium sponsored by Garrett Supply Co., Los Angeles. M. E. Greenhow, Garrett sales engineer, demonstrates grinding wheel to group of foundrymen.



Sand is distributed to molders' hoppers by a Link-Belt belt conveyor employing flat roll idlers. Car type mold conveyor and apron conveyor at left are also part of this foundry furnished complete by Link-Belt.

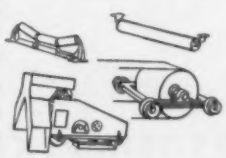
SURE ROAD TO LOWER HANDLING COSTS

... carry the load via Link-Belt belt conveyors

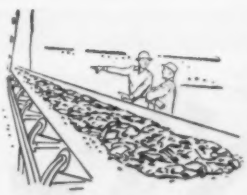
LINK-BELT offers you the "total engineering" so necessary for top efficiency

DESIGNED FOR OVERALL EFFICIENCY—Because of its unrivaled experience, Link-Belt can do a better job of gathering and analyzing all data. Proposals reflect this understanding of the most practical way to fit individual conveyors into your overall system requirements for best results.

BUILT FOR LONG-LIFE PERFORMANCE—Link-Belt manufactures all components and related feeders and conveyors. You are assured of the right equipment because of this breadth of line. And Link-Belt will supply the highest grade belts engineered to the specific job.



DELIVERS FULL RATED CAPACITY—Link-Belt follows through on every detail of the job, including electrical controls and even wiring and foundations. What's more, Link-Belt will furnish experienced erection superintendents, staffs and skilled crews at the customer's request.



ASSURES SATISFACTORY PERFORMANCE—When you rely on Link-Belt as a single source for your complete system, we accept responsibility for placing it in full operating readiness. We will also supervise modernization of existing systems. For all the facts call your nearby Link-Belt sales representative.

LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

12,486-D

DELTA
FAST-DRI
CORE OILS AND BINDERS

FOR
FASTER PRODUCTION
OF
BETTER CORES
at low cost!

Cores made with DELTA 155-X and 168-X FAST-DRI Core Oils have 1) — an unusually high tensile strength (20% greater than raw linseed oil), 2) — a lower gas ratio, 3) — a higher degree of elasticity and 4) — less core embrittlement.

Core sands made with DELTA FAST-DRI Core Oils have excellent flowability resulting in better workability in core boxes.

The uniformity of DELTA 155-X and 168-X FAST-DRI Core Oils is guaranteed. The chemical and physical constants are maintained by strict laboratory control.

DELTA

Working samples for test purposes together with complete data are available to you. Included, also, will be information on other Delta Core Oils, Delta Dri-Bond and DELTA BONDITE. Your request will receive immediate attention.

DELTA OIL PRODUCTS CO.

MANUFACTURERS OF SCIENTIFICALLY CONTROLLED FOUNDRY PRODUCTS

MILWAUKEE 9, WISCONSIN

Here's what makes the tractor shovel an outstanding performer on big-capacity material handling —

Users everywhere are finding the Allis-Chalmers HD-5G Tractor Shovel an excellent way to reduce production costs — not only because of its big handling capacity and economy, but because of its unusual versatility as well.

With Standard 1-yd. Bucket it is ready for any bulk material — loads trucks, feeds hoppers and conveyors, builds stockpiles.

With Lift Fork attachment it skids, stacks or loads packaged or palletized loads up to 4,000 lb., steel beams, pipe, lumber.

With big 2-yd. Light-Materials Bucket it doubles output in coal, coke, other light materials.

Where desired, the HD-5G can be adapted to other special requirements through use of Narrow Bucket, Rock Fork, Crane Hook — any of 13 attachments in all. These can be interchanged in about 20 minutes by simply removing and replacing four pins.

The thousands of HD-5G's can be found working indoors and out — in pits and mines, on stockpiles, around all types of plants. Their crawler treads provide traction for soft spots or steep climbs, smooth out travel over rough ground, fit them to work anywhere. Because of compactness and maneuverability, HD-5G's handle well in close quarters. With an over-all height of about 6 ft. (bucket down), they are used on many underground and other low-headroom jobs.

In winter, the HD-5G clears snow from yards, roads and parking lots — in addition to regular duties. With 40 brake hp., 16,200 lb. of weight and plenty of track on the ground, it isn't stopped by snow, ice or mud. Cabs protect operators from cold or sun.

The HD-5G isn't limited to handling materials. It clears or levels land for new construction, digs basements and trenches, backfills, builds and maintains roads, stockpiles and reclaims coal, saves money and man-hours on dozens of jobs the year around.

Ask for a demonstration — Your nearby Allis-Chalmers industrial tractor dealer will be glad to *show* you just what the HD-5G or one of the larger 2-, 3- or 4-yd. Tractor Shovels will do —right on your own job. Or write for additional information.

ALLIS-CHALMERS
TRACTOR DIVISION · MILWAUKEE 1, U. S. A.

Foundrymen in the News

Zigmond Madacey, formerly assistant foundry manager of Caterpillar Tractor Co., has joined Beardsley & Piper, Div. Pettibone Mulliken Corp., where he will

Zigmond Madacey . . . field service

be field service manager. Mr. Madacey will work with B. & P. Customers on problems of equipment, installation, servicing, and operation.

Exothermic Alloys Sales & Service, Inc., has appointed a new sales engineer representative in the east coast area: **Frank E. Smith,** formerly associated with Vesuvius Crucible Co.

Several promotions have been announced by Mackintosh-Hemphill Company's Garrison plant, Pittsburgh, Pa. **Thomas H. Pattison** has been named superintendent

J. B. McGlade . . . operations superintendent

of operations. **John B. McGlade,** formerly assistant plant metallurgist, has been promoted to plant metallurgist. **Charles W. Barker** will be new assistant metallurgist. **Oliver B. Douthett** will be general foreman of foundry operations, placing him in charge of the pattern shop, gray iron foundry, yard and furnaces, roll molding and casting.

William B. Wallis, Past-President of AFS, will be presented the distinguished alumnus award by Pennsylvania State University in June. The ceremony will salute the achievements of five outstanding graduates of the university, formerly known as State College of Pennsylvania.

W. H. Redhead has been named sales engineer by Kindt-Collins Co., and will cover most of Ohio, Michigan, and Indiana, and part of West Virginia.

Indiana Steel Prods. Co., Valparaiso, Ind., manufacturer of permanent magnets, has promoted two members of its executive personnel. **James R. Ireland,** formerly staff assistant to the vice-president in charge of research and engineering, has been appointed assistant director of research. **James G. Richmond** was named assistant manager of the manufacturing division.

Raymond Szymanowitz has been promoted from vice-president to executive vice-president of Acheson Industries, Inc.

As part of the reorganization plan at Frederic B. Stevens, Inc., Detroit, **Arthur H. Kirkpatrick** has been promoted to the new position of special project engineer.

A. H. Kirkpatrick . . . promoted at Stevens

Automatic processing equipment, automation in metal finishing, and waste disposal applications will be included in his work.

A. S. Kromer became general manager of the Calumet Div., Calumet & Hecla, Inc., Chicago, on March 15. He succeeds **Orson A. Rockwell,** who has resigned.

General Refractories Co., Philadelphia, has announced several changes in its sales organization. **Nelson W. Bowman,** formerly district sales manager at New York, has transferred to the main office in Philadelphia. **Edward E. Christopher,** recently St. Louis district sales manager, will head the New York sales office. **Thomas F. Fallon** becomes district sales manager in St. Louis. **David R. Sieber,** Pittsburgh, Pa. district sales manager, becomes a consultant in that office, with his assistant, **Ward M. Troutman,** succeeding him. **Fred W. Schwartz** moves up to assistant sales manager at St. Louis **Paul M. Johnson** is a new addition to the sales engineering staff in Cleveland.

John V. McCarthy has been appointed sales representative for Vesuvius Crucible Co. in the New England-eastern New York-metropolitan New York regions. McCarthy also represents North American Smelting Co., Wilmington, Del.

Clyde M. Adams, secretary, Bohn Aluminum & Brass Corp., has been loaned to the federal government, where he will serve as deputy director, aluminum and magnesium division, Business and Defense Services Administration, Department of Commerce. Mr. Adams will serve

C. M. Adams . . . government loan

under a rotation system, whereby industry makes available the services of experienced personnel for short periods of time.

Chris A. Zanlson has been appointed sales engineer in shell molding for Mechanical Handling Systems, Inc., Detroit. He will work with the firm's engineers also in the design and manufacture of automatic equipment for the shell mold foundry.

W. C. Wertz has joined Superior Steel & Malleable Castings Co. as Chicago representative. A graduate of Illinois Institute of Technology, he was formerly with General Motors and Chrysler Corp.

Ward A. Wickwire, Jr., president and director of Salem-Brosius, Inc., Pittsburgh, Pa., has been elected to the board of directors of Mellon-Stuart Co.

After 15 years of varied foundry experience, including a period as foundry training coordinator at the Mare Island (Calif.) Naval Shipyard, **Maurice C. Sandes** is now a field representative with the department of industrial relations, division of apprenticeship standards, state of California. Although his work will include many trades, he will concentrate on molding and coremaking operations.

Famous CORNELL CUPOLA FLUX

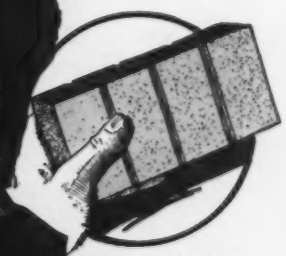
Take a Tip

FROM THE EXPERIENCE OF OTHERS!

(MANY LEADING FOUNDRIES)

Cleanse and condition molten iron with Famous Cornell Cupola Flux—and you'll see a big improvement in castings—cleaner, sounder, easier to machine.

Cupola operation is more efficient, too. And lining life is prolonged.



Approx. 4 pound Brick

PRE-MEASURED SCORED BRICK FORM is ready for instant use, no digging out of container, no weighing, no measuring.

Write for Bulletin No. 46-B

The Cleveland Flux Co.

1026-1040 MAIN AVENUE, N. W., CLEVELAND 13, OHIO

Manufacturers of Iron, Semi-Steel, Malleable, Brass, Bronze, Aluminum and Ladle Fluxes – Since 1918

FAMOUS CORNELL FLUXES

Trade Mark Registered

BRASS FLUX

FAMOUS CORNELL BRASS FLUX cleanses molten brass even when the dirtiest brass turnings or sweepings are used. You pour clean, strong castings which withstand high pressure tests and take a beautiful finish. The use of this flux saves considerable tin and other metals, and keeps crucible and furnace linings cleaner, adds to lining life and reduces maintenance.

ALUMINUM FLUX

FAMOUS CORNELL ALUMINUM FLUX cleanses molten aluminum so that you pour clean, tough castings. No spongy or porous spots even when more scrap is used. Thinner yet stronger sections can be poured. Castings take a higher polish. Exclusive formula reduces obnoxious gases, improves working conditions. Dross contains no metal after this flux is used.

Foundrymen in the News

continued from page 28

With the purchase of all the stock of Sutter Prods. Co. by **Ray H. Sutter,** president, announcement was made of the retirement of vice-president **Percy L. Sutter.** Several other personnel changes have been made: **Russell F. LaBeau** is now executive vice-president in charge of all operations; **George Buchanan** is vice-president in charge of sales and sales

R. F. LaBeau . . . Sutter exec v. p.

promotion; **Earl J. Blough** becomes chief engineer; **Oscar Bernth** is now plant manager; **J. A. Martineau** has been made general purchasing agent; **Seymour L. Collins** is now manager of material control and customer service.

The metals research department of Armour Research Foundation, Chicago, has a new senior metallurgist: **Gary Steven,** high-temperature metallurgy expert. The promotion recognizes Steven's outstanding work on many research projects, and constitutes the highest professional position at the Foundation.

John A. Baker, for nine years sales engineer in the Philadelphia area for Sterling Abrasives Div., Cleveland Quarries Co., of Tiffin, Ohio, will be district manager at the new sales office in Philadelphia. He will be succeeded as sales engineer by **Harold A. Skeen.**

Three metallurgical engineering students at Illinois Institute of Technology, Chicago, have been awarded tuition scholarships by Foundry Educational Foundation, Cleveland. The $325 awards were made to: **Ronald B. Diamond,** Chicago; **Fred L. Seppi,** Chicago; and **James M. Mosby,** Granite City, Ill.

Elmer F. King has been designated metal finishing sales representative in the New England area for Frederic B. Stevens, Inc. The company's Indianapolis office and warehouse will be headquarters for the central states district, with **Vince Bruce** as district sales manager. The metal finishing

R. H. Sutter . . . buys all stock

George Buchanan . . . heads sales

division will also have a sales district office at Dayton, Ohio, where **Harry Brown** has been promoted to district sales manager. **Collins F. Stevens** has been added to the Buffalo office, where he will represent the metal finishing sales division.

John D. Riley has been appointed as new district manager of the Cleveland office of Link-Belt Co., after five years in the same capacity at Newark, N. J. **Harry G. Anderson** will succeed him at Newark.

J. D. Riley . . . Cleveland manager

From headquarters in Bridgeport, Conn., **Clifford G. Strote** will operate as director of purchases for all divisions and subsidiaries of American Chain & Cable Co., Inc. **M. C. Ness** has been appointed as his assistant.

Stanley G. Benner has been added to the staff of the ceramic coating department, General Ceramics & Steatite Corp., Keasbey, N. J. The department produces protective coatings for high and low alloys, aluminum, carbon steel and cast iron. Pittsburgh technical section of International Nickel Company's development and research division, has appointed **Robert J. Johnson** as metallurgist. A registered professional engineer, Johnson is also a member of A.I.M.M.E. and A.S.M.

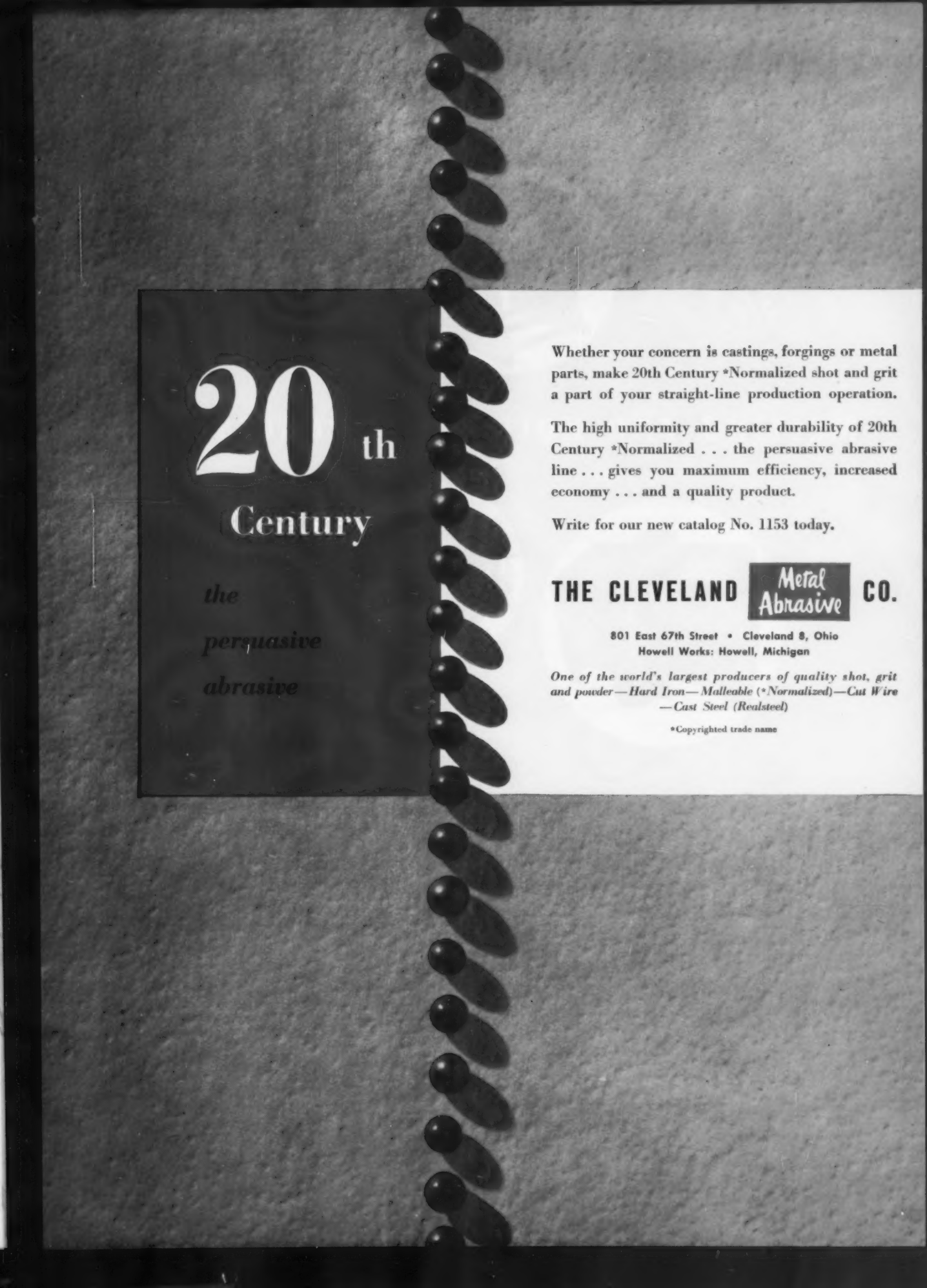
Formerly assistant metallurgist at Lebanon Steel Foundry, **Harold C. Templeton** has been promoted to chief metallurgist. **Ray W. Patridge** has assumed the position of service manager. New chief planning engineer is **Roy W. Daub.**

Four executives have been promoted at Faul Corp., Milwaukee. **Carl F. Haertel** is now division works manager of the foundry and weld shop. He has been with Falk since 1919. Now director of plant engineering is **Foster C. Koehn. Robert H. Weaver,** industrial relations director, will concentrate on over-all employee relations. **Charles Fuerst** has been named general foundry superintendent, after serving as assistant superintendent since 1950.

Arthur Townhill has been appointed associate project director for engineering activities relating to non-ferrous castings at Alloy Engineering and Casting Co., Champaign, Ill. He will work on Air Force contracts and research relating to Aircraft Industries Association.

Three new district sales managers have been appointed by Charles Taylor Sons Co., subsidiary of National Lead Co., **G. K. Lowe** will function in northern Ohio, western New York, and northwestern Pennsylvania, with offices in Cleveland. **W. C. Pittman** will cover southern Ohio and parts of Indiana and West Virginia. With headquarters in Pittsburgh, Pa., **L. R. Burke's** district will include western Pennsylvania, eastern Ohio, and northern West Virginia.

H. G. Andersen . . . Link-Belt, Newark



Whether your concern is castings, forgings or metal parts, make 20th Century *Normalized shot and grit a part of your straight-line production operation.

The high uniformity and greater durability of 20th Century *Normalized . . . the persuasive abrasive line . . . gives you maximum efficiency, increased economy . . . and a quality product.

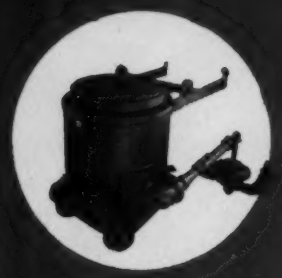
Write for our new catalog No. 1153 today.

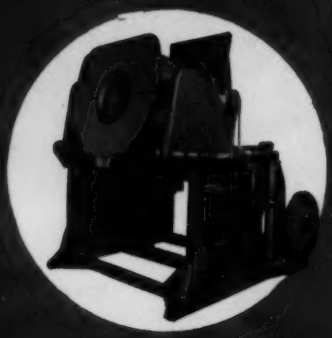
THE CLEVELAND Metal Abrasive CO.

801 East 67th Street • Cleveland 8, Ohio
Howell Works: Howell, Michigan

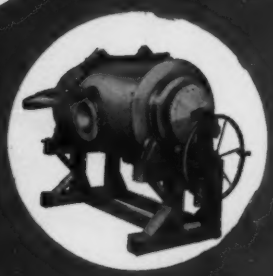
*One of the world's largest producers of quality shot, grit and powder—Hard Iron—Malleable (*Normalized)—Cut Wire —Cast Steel (Realsteel)*

*Copyrighted trade name





MELTING AND HOLDING FURNACES



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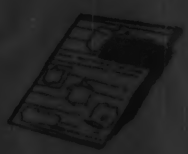

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Calcium Carbide Injection— A New Foundry Tool

H. E. Henderson / *Research Metallurgist, Lynchburg Foundry Co., Lynchburg, Va.*

J. M. Crockett / *Mgr., Metallurgical Section, Air Reduction Sales Co., New York*

Finely divided calcium carbide injected into molten iron by means of dry nitrogen removes sulphur, permits use of more economical alloy additions, and provides a base for conversion to spheroidal graphite. Conversion can be made through injection. Written discussion of this paper, Convention Preprint No. 54-8, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Gray Iron Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ Calcium carbide has been used for many years as a reducing agent and a desulphurizer in basic electric furnace steel making. An investigation by Wood, Barrett and Holbrook[1] in 1940 indicated that under carefully controlled conditions, calcium carbide would desulphurize gray iron efficiently.

Because the melting point of calcium carbide is much higher than temperatures normally obtained in iron or steel-making operations, to bring about a reaction between the carbide and molten iron, it is necessary to provide a means of intimate contact of the finely divided carbide with the molten iron. In the presence of molten iron, the carbide will decompose quite rapidly and its effectiveness as a desulphurizing agent is quickly lost. Thus, the solution to the mechanical problem of bringing about the proper contact of solid calcium carbide and molten iron is limited to those methods which cause this contact to occur substantially below the surface of the molten metal.

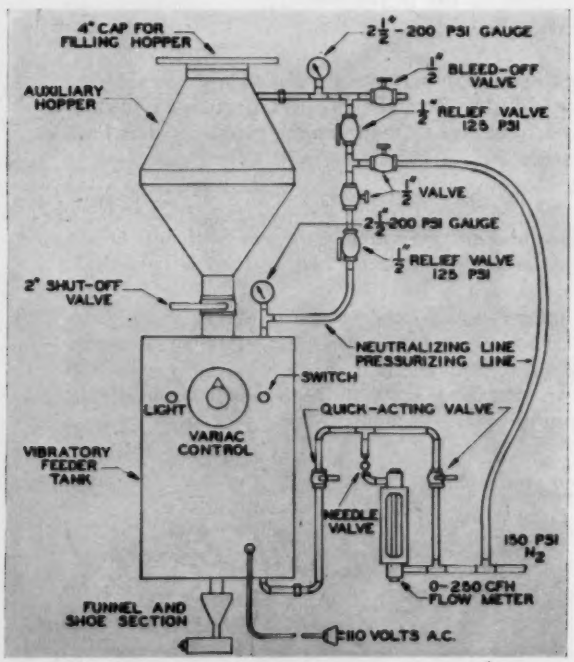


Fig. 1—Diagram of calcium carbide feeder.

Carrier-Gas Stream

Various attempts to solve this problem and the history of the development of equipment now in use have been described by Baumer and Hulme[2], and by Henderson and Hulme.[3] Injection of the solid calcium carbide into liquid iron using a carrier-gas stream was found to be the method which gave the most consistent results and which seemed to have the best potential for adapting to commercial operation. Nitrogen gas is usually employed as the carrier of the carbide particles. Carbon dioxide and argon have given equally good results metallurgically. Neither air nor oxygen is satisfactory.

The equipment used for the calcium carbide injection process consists of three elements: (1) A feeding mechanism to mix the carbide and the carrier gas in the proper proportions, (2) A conveying line to bring the carbide-gas mixture to the point of use, and (3) An injection tube to bring the carbide-gas mixture below the surface of the molten metal.

Figure 1 is a line drawing of the feeding mechanism now in use in several foundries. This is a vibratory feeder in which the calcium carbide feed rate is con-

trolled by means of a vibrating chute. It is equipped with an auxiliary hopper to permit charging while in operation without interrupting the flow of carbide into the metal. Other types of feeding mechanisms which have been used were based on a screw feed principle to control the carbide feed rate or pneumatic means to control the carbide rate and carbide-gas mixture.

The feeding mechanism must permit independent control of gas flow and calcium carbide feed rate. In addition, the proportion of gas to solid should be maintained within limits. If too much gas is used per pound of carbide, a large portion of the carbide is carried through the bath without reacting with the metal. If too little gas is used, the injection tube is blocked and flow stops. In commercial production, the nitrogen gas flow is generally set between 100 to 150 cu ft per hour for calcium carbide feed rates between two and six pounds per minute.

Conveyor Determined by Conditions

The conveying line can be copper tubing or rubber hose. Choice of length, diameter, and type of conveying line used depends upon the conditions in the particular location at which calcium carbide injection is used.

The tubes which are placed into the molten metal to convey the calcium carbide-gas mixture below the surface have been developed along two lines. First, where the injection process is used in ladles or on a batch basis, graphite tubes have been used (Fig. 2). They have the advantage of being inert to the calcium carbide, have high heat shock resistance, and high thermal conductivity. Second, where the injection process is used on a continuous basis and tube life becomes an important factor, a composite refractory and graphite tube, as shown in Fig. 3, has been found to give satisfactory performance (tube life of 2½ to 4 hours at temperatures 2800-2750 F). In this design, the graphite inner tube is protected by a refractory cover.

Operating Problems. The operation of the equipment previously described under foundry operating conditions, presented several problems which are inherent in the calcium carbide injection process.

The slag formed by calcium carbide injection is dry and granular. While it separates readily from the molten iron, it can be removed from the surface of the iron only by some mechanical means, such as rabbling. In a continuous operation, the slag can be pulled off by hand (Fig. 4) or if desired a mechanical rabble can be used. The carbide slag can be quenched in water and handled with the usual slag handling facilities.

The injection tube used for continuous operation should be made up at least 24 hours before use, air dried for eight hours and baked for 16 hours. Prior to actual use in the metal, the tubes should be preheated with a torch. The tube should be constructed so that all refractory joints are above the surface of the molten metal. This provides a satisfactory injection depth with 18-in. refractory sleeves. The depth of the tip of the injection tube should be kept constant; a minimum of 8 in. below the surface of the metal or one half the depth of the treating vessel. If possible the tube should be positioned to enable the carbide particles to be

Fig. 2—Injection assembly ready for use. Immersed tube is made of graphite for intermittent use.

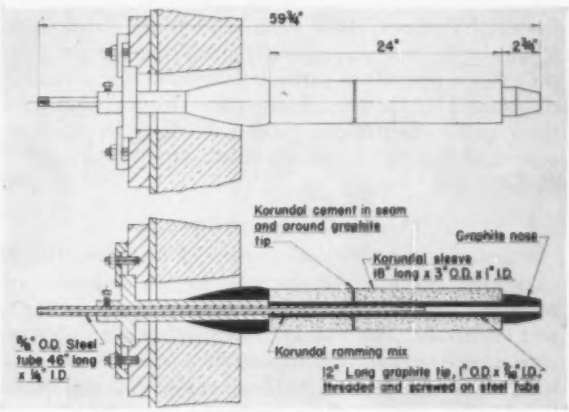

24"
Korundal cement in seam and around graphite tip
Graphite nose
Korundal sleeve 18" long x 3" O.D. x 1" I.D.
Korundal ramming mix

Fig. 3—Details of composite refractory and graphite injection tube for continuous operation.

forced to the bottom of the vessel by the carrier gas before they start to float to the surface.

The injection equipment (Fig. 5) must be checked periodically for leaks, and occasionally given a calibration run. During operation of the injection equipment, pressure readings and settings of gas and calcium carbide flow should be noted in order to insure uniform operation of the equipment.

Desulphurization. Although the original objective of plant-scale work with calcium carbide was for desulphurizing only, it has been found in the laboratory and confirmed in the field that carbide can be used to achieve several important metallurgical effects in gray iron. Since, however, the basic step in accomplishing any results with carbide is to efficiently, consistently, and economically desulphurize the metal, the results

Fig. 4—Slagging the carbide bath during continuous desulphurizing operation. Water disposal of slag is used.

obtained with carbide for desulphurization will be discussed first.

Calcium carbide has been used to desulphurize acid cupola melted iron from an average sulphur content in the range of 0.07-0.12 per cent to a sulphur level of 0.009 to 0.02 per cent. This is a continuous operation and the carbide is injected into a bath as shown in Fig. 6. By controlling the rate of carbide injection, sulphur at the desired level may be obtained from the forehearth. In the continuous operation, it has been found that the carbide requirement for sulphur removal is the same as originally established in the laboratory: ten pounds of carbide to remove one pound of sulphur. The carbide requirement for desulphurization in the continuous process holds quite constant over a wide range of final sulphur analysis, from 0.08 to 0.015 per cent.

Table for Continuous Operation

Figure 7 compares the amount of carbide required to remove sulphur and the amount of fused soda ash required under the continuous operating conditions at Lynchburg. The efficiency of carbide desulphurization does not diminish appreciably in the lower final sulphur ranges (0.05 to 0.015 per cent). Whether or not carbide is economically competitive to fused soda ash in continuously desulphurizing to a 0.08 per cent final sulphur must be determined in each application. However, it has been demonstrated that carbide is an economical method to consistently control final sulphur content in the 0.01 to 0.035 per cent range.

TABLE 1—EFFECT OF TEMPERATURE AND FEED RATE ON DESULPHURIZATION EFFICIENCY OF CALCIUM CARBIDE

Ladle No.	Metal Wt., Pounds	Temp., deg. F	Carbide Feed Rate, lb./min	Final S	Desulph.* Ratio
1	1500	2720	3.8	0.032	10.8
2	1100	<2600	14.5	0.084	27.8
3	900	2610	6.0	0.040	10.3
4	800	2480	6.0	0.065	16.5
5	2300	2745	3.2	0.014	9.6
6	1000	2720	5.4	0.015	31.2

*Pounds of calcium carbide required to remove one pound of sulphur.

Fig. 5—Carbide feeders set up for double injection.

The continuous injection of calcium carbide in a treating basin gives the optimum condition for desulphurization, and consequently the lowest carbide consumption per pound of sulphur removed. In the course of development work in other foundries, a considerable amount of data has been obtained using carbide desulphurization on batch or individual ladle treatment. This work has brought out various factors which have an effect upon the desulphurizing efficiency of calcium carbide. Because the data were obtained under a wide variety of operating conditions, extreme conditions were encountered which made interpretation of results difficult. However, the factors which are important and should be controlled are: temperature, carbide feed rate, lining of treating vessel, depth of immersion tube, and size of treating vessel.

Temperature, Desulphurizing Tables

Figures 8 and 9 show the effect of treating temperature and rate of calcium carbide injection on desulphurizing efficiency. These curves represent results obtained in preliminary test work, and show a range of practices and their effect on carbide efficiency. For example, Table 1 contains representative data on individual ladles used to determine the curves of Fig. 8 and Fig. 9.

Ladles 1 and 2 represent the difficulty in interpreting the influence of temperature or feed rate. Obviously under shop conditions where low temperatures are encountered, high feed rates must be used in order to have sufficient temperature remaining to pour the

TABLE 2—IMPROVEMENT IN PHYSICAL PROPERTIES OF SOME PRODUCTION IRONS BY INJECTION OF CALCIUM CARBIDE

Lab. No.	Chemical Analysis Si	S	P	Mn	TC	Mo	Cr	Cu	Physical Properties Trans.	Def.	Tensile	BHN
12195 Untreated	2.69	.058	.035	1.01	3.03	0.70	....	1.32	3686	.360	54,850	285
12215 Treated	2.41	.047	.035	1.00	3.01	0.72	....	0.94	3843	.328	61,210	255
12213—14 Untreated	1.88	.081	.062	1.00	3.49	....	0.30	....	1916f	.212	33,030	212
12213—6 Treated	1.89	.041	.062	0.70	3.46	....	0.72	....	2335f	.284	35,150	207
12355 Treated	1.67	.040	.095	0.87	3.37	....	0.38	....	2856	.324	42,130	217
15514 Treated	1.48	.038	.073	0.76	3.46	....	0.37	....	2944	.328	45,620	223
15525 Untreated	1.54	.052	.092	1.11	3.67	0.30*	0.25*	0.30*	2318	.248	34,250	207
15527 Treated	1.78	.032	.106	1.17	3.56	0.30*	0.25*	0.30*	2620	.272	44,120	187
15738 Untreated	1.65	.078	.110	0.65	3.54	0.27	0.24	0.33	2655	.328	36,160	207
15724 Treated	1.71	.041	.104	0.67	3.55	0.25	0.23	0.29	2829	.320	43,800	228

*Estimated
f—Flawed bar
Physical properties were measured in accordance with ASTM A-48-48 Specification on a 1.2-in. dia. test bar "B".

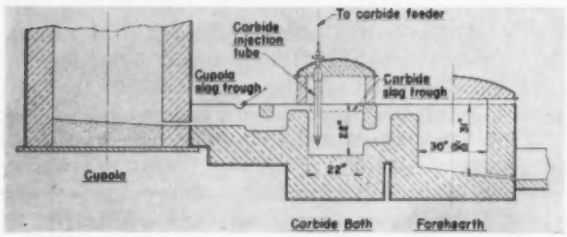


Fig. 6—Treating basin for continuous injection of calcium carbide. Injection rate controls sulphur content.

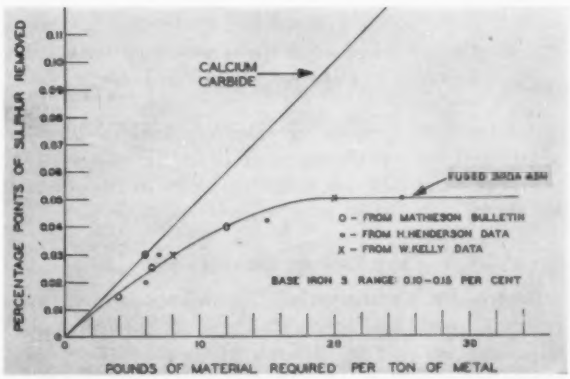

PERCENTAGE POINTS OF SULPHUR REMOVED
CALCIUM CARBIDE
FUSED SODA ASH
O – FROM MATHIESON BULLETIN
• – FROM H.HENDERSON DATA
X – FROM W.KELLY DATA
BASE IRON S RANGE 0.10–0.15 PER CENT
POUNDS OF MATERIAL REQUIRED PER TON OF METAL

Fig. 7—Typical desulphurization results (continuous operation) using calcium carbide and fused soda ash.

metal. This is the extreme condition. Ladles 3 and 4 are better indications of possible temperature effects. Ladles 5 and 6 are included, since in many cases metal was deliberately overtreated insofar as sulphur removal was concerned. Because of analytical limitations, any desulphurization ratios calculated on final sulphur of less than 0.02 per cent may be high.

Effect of Ladle Lining

The influence of the ladle lining on straight desulphurization is not as important as might be expected. The slag resulting from calcium carbide injection is dry and does not react appreciably with acid ladle refractories. The data indicate somewhat more consistent results using basic-lined ladles than those with an acid lining, but, in general, more care was given to basic-lined ladles in most tests and they were cleaner and free of cupola slag contamination.

The immersion depth of the injection tube must be kept constant in order to obtain consistent desulphurization. The tube depth should be maintained at least one half the depth of metal for consistent results.

While curves No. 8 and 9 indicate that a wide variation in desulphurization efficiency may be encountered in preliminary investigations of the process, they do indicate that the optimum results with desulphurization in ladles or on a batch basis will be obtained with metal temperatures over 2600 F and carbide feed rates of less than five to six pounds per minute.

Desulphurizing to Less than 0.02 Per Cent Sulphur. To reduce sulphur content to less than 0.02 per cent in an iron melted in an acid cupola* is difficult with any of the commonly used desulphurizing agents. It is possible with magnesium or cerium alloys but they are expensive and more difficult to control. With a calcium carbide injection, sulphur under 0.02 per cent may be obtained economically and with little difficulty. Acid cupola iron desulphurized to such an extent with calcium carbide, shows much less chilling tendency than regular iron of the same composition. This treated iron will have a lower chill depth and Brinell hardness number for the same or greater tensile strength, as shown in Table 2.

The properties of the irons shown in Table 2 are representative of irons regularly in production. It may be seen that there is an improvement in physical prop-

*Acid Cupola Slag: $\frac{CaO \cdot MgO}{SiO_2 \cdot Al_2O_3} = 0.25$ to 0.45

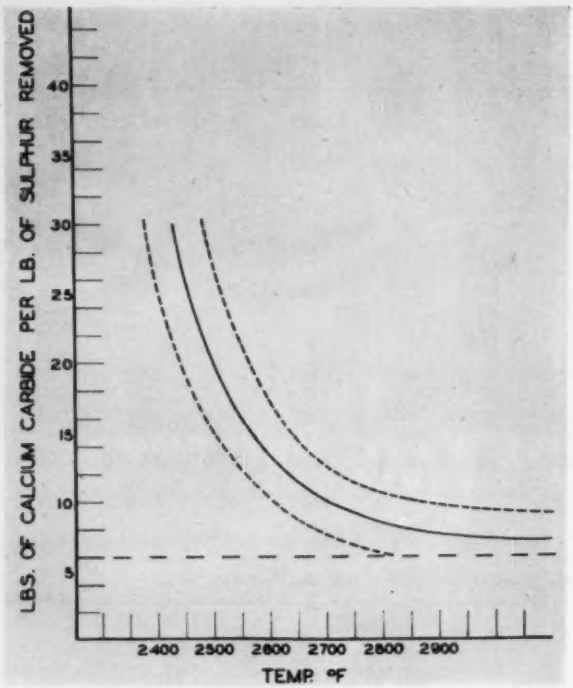


Fig. 8—Change in desulphurizing efficiency with metal temperature. Data are shown in Table 1.

erties by the injection of calcium carbide. The improvement in tensile strength is in the range of 12 per cent in the higher strength irons to 38 per cent for those with 30,000 psi tensile strength.

Less Chilling Reduces Cost

There is the added possibility of substituting lower priced alloy combinations for the more expensive alloy additions because of this reduction in chilling tendency. For example, for an iron requiring 40,000 psi minimum tensile strength in the total carbon range of 3.35-3.45 per cent, an alloy addition of one per cent ferromolybdenum plus 0.8 per cent copper, or 0.50 per cent ferromolybdenum plus 0.50 per cent ferrochromium plus 0.3 per cent ferrovanadium is required to obtain this minimum tensile. In the case of the calcium carbide treated iron using one per cent calcium carbide and one per cent ferrochromium, the tensile strength is well above 40,000 psi and the cost of this alloy addition is only 30 per cent of the cost of the regular alloy addition. That this treated iron is equal in all respects to regular alloyed iron will have to be ascertained by further tests, but the structure and physical properties indicate that it is as good if not better.

Desulphurizing as a Base for Nodular Iron. The injection of calcium carbide, or carbide mixtures, into the base iron used for producing spheroidal graphite iron has three definite advantages. The first is a reduction in magnesium and/or cerium alloy due to removal of sulphur and promotion of the formation of spheroidal graphite with a lower residual magnesium. The second advantage is that the calcium carbide treatment reduces the tendency to form cementite in the as-cast spheroidal iron. The third benefit of carbide treatment is better control of the final product due to a minimum of variation in base sulphur analysis and residual magnesium.

For example, early work conducted with an iron melted in an induction furnace, shown in Table 3, shows that a reduction in the spheroidizing alloy addition of 30 per cent is possible when calcium carbide is injected prior to the alloy treatment. The spheroidizing alloy addition may be reduced 60 per cent if a prior injection of carbide and magnesium oxide is used.

Table 4 provides data from more recent experiences in the use of calcium carbide injection in the production of spheroidal graphite cast irons from a production electric furnace and an acid cupola. From the electric furnace heats it may be seen that very low additions (0.5 and 1.0 per cent of magnesium alloy) were sufficient to produce satisfactory spheroidal graphite cast iron following the injection of calcium carbide and magnesium oxide. The data from acid cupola melted iron show that a reduction in alloy of 20 per cent could be readily made when calcium carbide alone was used. This amount of alloy reduction was achieved by lowering the base sulphur to 0.04 per cent with calcium carbide. When improvements are completed in

TABLE 3—PHYSICAL PROPERTIES OF BASIC INDUCTION MELTED IRON TREATED WITH CALCIUM CARBIDE AND MAGNESIUM ALLOY

	Treatment, lb./ton			Chemical Analysis							Tens. Str.,		Elong., %
Heat No.	CaC_2	MgO	NiMg*	FeSi	TC	Si	Mn	S	P	Mg	psi	BHN	in 2 in.
381-1	..	..	..	30	3.89	3.44	.220	.014	.038	<.001	12,500	87	0
381-2	..	..	28	18	3.57	3.28	.178	.009	.011	.048	67,000	170	11
381-4	30	..	20	20	3.54	3.57	.207	<.005	.040	.038	73,200	187	8
383-1	..	..	..	30	4.08	3.62	.224	.012	.043	<.001	16,200	92	0
383-2	..	..	28	18	3.53	3.32	.225	<.005	.043	.055	71,150	167	11
383-4	30	5	10	26	3.37	3.58	.222	<.005	.044	.029	65,000	174	7
386-1	..	..	..	30	3.96	3.54	.195	.017	.054	<.001	14,600	87	0
386-2	..	..	28	18	3.67	3.09	.199	.008	.042	.037	64,750	163	9
386-4	15	5	10	26	4.03	3.36	.195	<.005	.046	.026	62,700	167	6
390-1	..	..	..	30	3.91	3.32	.196	.018	.046	....	14,300	90	0
390-2	..	..	28	18	3.58	3.09	.192	.009	.045	.040	68,900	174	10
390-4	30	..	20	20	3.44	3.02	.191	<.005	.044	.053	68,900	163	13
391-1	..	..	..	30	3.90	3.18	.198	.011	.044	....	15,070	95	0
391-2	..	..	28	18	3.32	3.16	.199	.006	.043	.081	72,100	174	11
391-4	30	..	20	20	3.49	3.21	.197	<.005	.040	.065	70,150	179	7

* #2 NiMgSi Alloy

TABLE 4—PHYSICAL PROPERTIES OF ELECTRIC FURNACE AND CUPOLA MELTED IRON TREATED WITH CALCIUM CARBIDE AND MAGNESIUM ALLOY

Ladle	Treatment, per cent					Chemical Analysis					Physical Properties			Melting
No.	CaC_2	MgO	Misch	NiMg	FeSi	Si	S	P	Mn	TC	Tensile	Elong.	BHN	Unit
3-9-1-1	....	....	....	...	...	1.24	0.04	0.033	0.30	3.74	.....	....	...	El. Fur.
3-9-1-3	0.64	0.21	....	...	1.5	1.95	0.02	0.037	0.29	3.54	20,000	1.0	129	" "
3-9-1-6†	0.64	0.21	....	0.5**	1.5	2.17	0.01	0.035	0.30	3.50	76,500	9.0	187	" "
5-21-6-1	....	....	....	...	...	0.87	0.045	0.041	0.21	3.85	.....	....	...	" "
5-21-6-3	1.28	0.22	....	1.0*	1.6	2.60	0.01	0.038	0.21	3.71	72,000	17.0	177	" "
L-19-1	....	....	....	...	1.5	2.58	0.052	0.13	0.43	3.67	18,200	....	143	Cupola
L-19-3	1.3	....	0.05***	0.5	1.25	2.15	0.012	0.14	0.44	3.67	88,600	1.0	255	"
L-20-1	....	....	....	...	1.5	2.15	0.052	0.09	0.39	3.72	17,000	....	140	"
L-20-3	1.5	....	0.16***	0.5	1.25	2.46	0.011	0.10	0.40	3.68	103,600	2.5	262	"
1759	....	....	0.06	2.5	1.5	2.49	0.020	0.072	0.35	3.48	113,250	4.5	228	"
1764	1.0	....	0.06	2.0	1.5	2.19	0.020	0.072	0.35	3.48	113,400	5.5	212	"
1737	....	....	0.06	2.5	1.5	2.67	0.016	0.042	0.42	3.60	105,975	2.5	255	"
1741	1.0	....	0.06	2.0	1.5	2.40	0.018	0.042	0.41	3.57	104,450	6.0	228	"
1658	....	....	0.06	2.5	1.5	2.82	0.022	0.067	0.32	3.53	97,550	2.0	269	"
1662	....	....	0.06	2.5	1.5	2.67	0.022	0.067	0.32	3.52	115,800	5.5	286	"
1668	....	....	0.06	2.5	1.5	2.65	0.020	0.067	0.32	3.46	108,950	4.5	248	"
1727	1.0	....	0.06	2.5	1.5	2.13	0.022	0.065	0.31	3.50	83,825	11.0	196	"
1731	1.0	....	0.06	2.5	1.5	2.10	0.028	0.065	0.31	3.56	97,825	8.5	202	"
1734	1.0	....	0.06	2.5	1.5	2.57	0.026	0.065	0.31	3.45	86,125	12.0	187	"

Physical properties are for a 1-in. keel block
*MgCe alloy
**CuSiMg alloy
***Rare earth oxides
†Residual magnesium is 0.015 per cent

TABLE 5—PHYSICAL PROPERTIES OF SPHERIODAL GRAPHITE IRON MADE BY INJECTION OF CALCIUM CARBIDE—NICKEL MAGNESIUM MIXTURE

Ladle	Treatment, per cent				Chemical Analysis						Physical Properties			Melting
No.	CaC_2	NMA	MgO	FeSi	Si	S	P	Mn	TC	Mg	Tensile	Elong.	BHN	Unit
Base														
384-1	...	...	...	1.5	3.11	.013	.061	.20	3.89	<.001	14,700	....	...	A
384-2	...	1.4	...	0.9	3.16	.010	.050	.20	3.40	.050	72,400	11.0	170	A
384-3	1.5	1.0	...	1.0	3.21	<.005	.055	.19	3.49	.037	72,400	11.0	170	A
385-2	...	1.4	...	0.9	3.17	.006	.047	.21	3.38	.054	72,650	12.0	174	A
385-3	1.5	0.5	.25	1.3	3.23	<.005	.052	.20	3.27	.018	61,800	6.0	170	A
L-56-2	1.0	0.5	...	1.25	2.13	.006	.086	.40	3.82	.051	78,500	4.0	207	B
L-67-2	1.78	0.5	.06*	1.25	2.25	.010	.60	.50	3.45	....	83,100	....	269	C

A—Laboratory Induction
B—Basic Cupola
C—Neutral Cupola
*—Mischmetal

Basic Cupola Slag: $\frac{CaO \cdot MgO}{SiO_2 \cdot Al_2O_3} < 1$

Neutral Cupola Slag: " 0.85 to 1.0

the production facilities for injecting calcium carbide, base sulphur levels of 0.01 to 0.02 per cent will result in a further reduction in alloy.

An examination of the last six ladles listed in Table 4 shows the lower Brinell hardness and higher elongations of the calcium carbide treated irons.

This is an indication that calcium carbide treatment reduces the tendency to form cementite in the as-cast structure of spheroidal graphite cast irons.

A magnesium-bearing alloy may be added in the usual manner or can be injected into the molten metal with calcium carbide. Table 5 shows results of both laboratory and plant scale heats in which the magnesium alloy was injected. Although the technique of injecting metallics into iron is slightly different from injecting non-metallics, the same equipment can be used. Changes in injection tube diameter and feed rates are necessary to inject metallics without plugging the injection tube.

Upgrading Physicals Forming Spheroidal Graphite. By treating a base iron of proper composition with varying amounts of calcium carbide or mixtures of calcium carbide and other materials, it is possible to produce irons with different tensile strengths. In general, the base iron composition should have a minimum of 3.5 per cent C, 2.0 per cent Si, and a maximum of 0.50 per cent Mn. The sulphur, before the injection treatment to upgrade physical properties, should be in the range of 0.02 to 0.03 per cent.

Such a base iron composition can be secured by melting a selected charge in an acid cupola and desulphurizing with calcium carbide, by melting in the basic cupola, or by melting in electric furnaces. Table 6 shows results obtained in treating base irons from these various sources with carbide and/or other materials.

Injection and Tensile Strength

Irons with properties of 40,000, 50,000, 60,000, 70,000 and 80,000 psi tensile strength can be produced by selecting the proper injection treatment. The treatment selected will depend upon the final properties required in the metal. For example, if an increase in

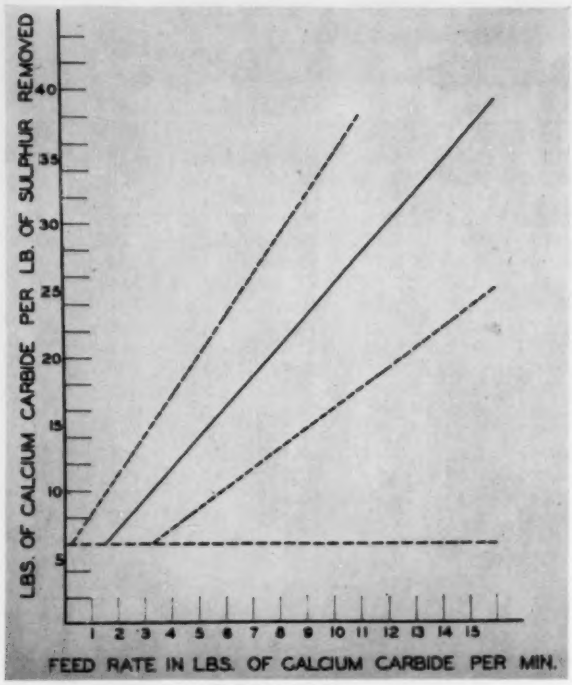


Fig. 9—Effect of calcium carbide feed rate on desulphurization efficiency. See Table 1.

tensile strength without increasing hardness appreciably is desired, a mixture of carbide and magnesium oxide can be injected and followed by a late ferrosilicon addition. An example of this is Ladle No. 383-3, Table 6. If, however, measurable elongation or reduction of area is required, rare earth oxide can be injected with carbide and/or magnesium oxide (Ladle No. 437-3, Table 6). By varying the rare earth oxide addition, the elongation can also be changed.

Controlled Factors

When injecting mixtures of calcium carbide, magnesium oxide and/or rare earth oxides to obtain improvement in properties, two factors must be controlled. The first is the sulphur level before injection and the second is the temperature. If the initial sulphur is in the range of 0.04 to 0.12 per cent, calcium carbide can be used to desulphurize and the calcium carbide in combination with the other materials can then be injected as a second stage treatment. When upgrading physical properties by injecting carbide or carbide with magnesium oxide or rare earth oxides, the temperature of the metal should be at least 2650 F at the start of the injection. In addition, for most consistent results, the ladle or forehearth used for the upgrading treatment should be lined with basic refractory. An example of such results is shown in Fig. 10, which illustrates how additions of magnesium oxide or rare earth oxides can be used. Irons of different composition would show similar changes in relation of properties.

Figures 11, 12 and 13 show the various stages of upgrading physical properties for different treatments. The structure of calcium carbide, or calcium carbide-magnesium oxide treated irons exhibit typical flake graphite structure in the lower degree of upgrading.

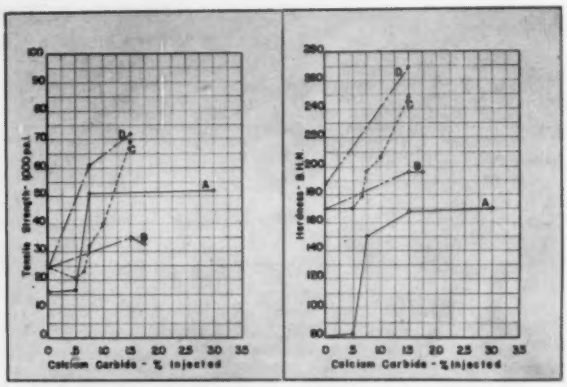


Fig. 10—Effect of amount of carbide injected on tensile strength and hardness of several irons. Curve A is an induction furnace iron (TC 4.00, Si 2.00, Mn 0.20, S 0.02, P 0.045) treated with CaC_2 plus 0.25 per cent MgO. B is a neutral cupola iron (TC 3.60, Si 1.60, Mn 0.50, S 0.08, P 0.45) treated with CaC_2. C is neutral cupola iron treated with CaC_2 and 0.25 per cent MgO. D is same as C but treatment included 0.05 per cent rare earth oxide. A 1.5 per cent late addition of ferrosilicon was made in all cases.

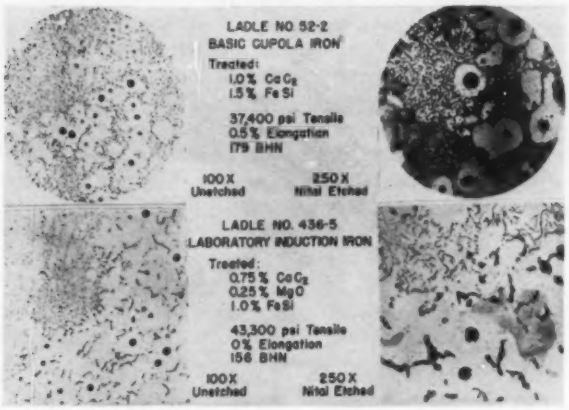
As the amount of upgrading increases, due to the use of more treating agent or an increased amount of inoculant, the graphite flakes become shorter and more compact, as shown in Fig. 11. The flakes then begin to curl and some spheroids appear (Fig. 12). The ultimate in upgrading is an iron containing graphite essentially in the spheroidal form as illustrated in Fig. 13. In addition, Fig. 11, 12 and 13 compare results obtained under laboratory conditions with results obtained under plant operating conditions. Correlation of results of this type of upgrading with different melting units has been very good.

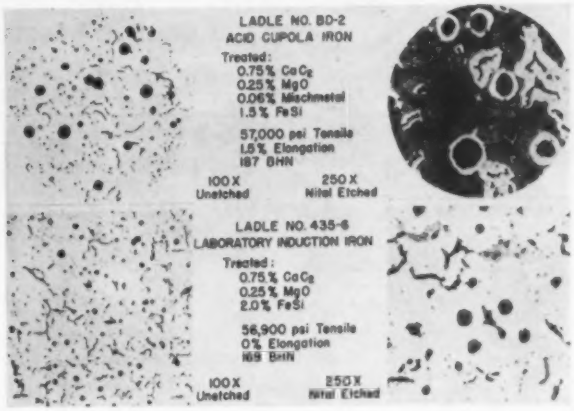
The importance of the late ferrosilicon addition to the upgrading of carbide treated irons is shown in Table 7. Marked increases in physical properties are obtained by additions of two per cent or more of ferrosilicon after treatment with either calcium carbide or calcium carbide and magnesium oxide.

Another modification possible in upgrading with calcium carbide injection is to cast the carbide treated iron on a chill to produce a white iron and then anneal. Table 8 shows results obtained with various treating agents and Fig. 14 shows the heat-treated properties compared with properties obtained in a 1-in. keel block as-cast.

Chilled Casting in Graphite

The properties shown in Table 8 were obtained by heat treating a bar $\frac{5}{8}$ in. square and 8 in. long, cast in a graphite mold to obtain a chilled casting. The result was a white iron bar which was subsequently heat treated and tested. The heat treatment consisted of heating the bar to 1700 F and maintaining this temperature for one and one-half hours, cooling to 1500 F and holding for one and one-quarter hours, cooling to 1300 F at rate of 100 F per hour, holding for one and one-half hours at 1300 F, cooling to 1000 F and holding for one hour, and finally cooling to room temperature.





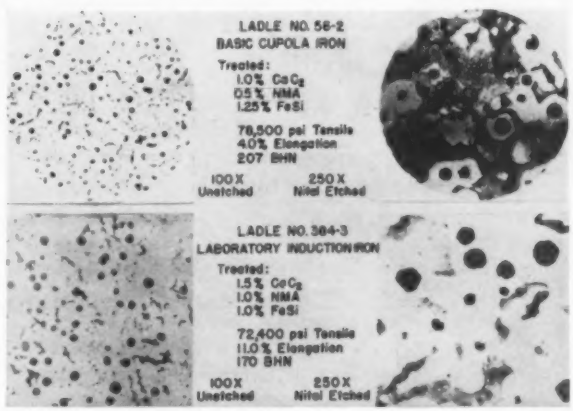


Fig. 11 (above); 12 (right above); and 13 (lower right)—Effects of injection treatments (calcium carbide and others) on microstructure and mechanical properties.

These results were confirmed in the plant by producing spheroidal graphite pipe by the deLavaud process using carbide in combination with either magnesium oxide, rare earth oxides or nickel magnesium alloy.

Summary and Conclusions

One primary effect of calcium carbide treatment is a reduction in sulphur, which may be reduced to any level desired. It must be realized that an addition of

TABLE 6—IMPROVEMENT IN PHYSICAL PROPERTIES OBTAINED BY INJECTION OF CALCIUM CARBIDE, CALCIUM CARBIDE-MgO, CALCIUM CARBIDE-REO AND CALCIUM CARBIDE-MgO-REO MIXTURES

Ladle	Treatment, per cent				Chemical Analysis						Physical Properties			Melting
No.	CaC_2	MgO	REO	FeSi	Si	S	P	Mn	TC	Mg	Tensile	Elong.	BHN	Unit
L-52 Base	....	...	...	...	1.00	.028	.062	.40	3.75	....	27,000	...	163	A
L-52-2	1.0	...	...	1.5	1.93	.011	.100	.36	3.77	....	37,400	0.5	179	A
Base 381-1	....	...	...	1.5	3.44	.014	.038	.22	3.89	<.001	12,500	...	87	B
381-3	1.5	...	...	1.5	3.49	<.005	.040	.20	3.92	<.001	41,900	...	167	B
Base L-23-1	....	...	...	1.5	2.95	.063	.50	.46	3.54	....	28,280	...	179	C
L-23-3	1.56	...	...	1.5	3.22	.012	.50	.46	3.54	....	35,600f	...	196	C
L-32-4	0.75	.25	...	1.5	2.91	.005	.50	.43	3.55	....	32,100	...	196	C
386-3	0.75	.25	...	1.5	3.36	<.005	.053	.19	3.72	.006	54,400	2.0	149	B
L-34-4	1.00	.25	...	1.5	2.79	.014	.50	.43	3.33	....	40,400	...	207	C
L-55-2	1.00	.25	...	1.5	1.96	.008	.11	.37	3.77	<.010	76,100	5.0	196	A
L-38-4	1.50	.25	...	1.5	2.51	.006	.40	.44	3.69	....	68,700	...	248	C
383-3	1.5	.25	...	1.5	3.48	<.005	.046	.22	3.65	.008	56,000	...	170	B
L-54-2	1.0	...	.05	1.5	1.92	.005	.09	.40	3.73	....	71,200	4.0	196	A
L-19-2	1.30	...	.05	1.5	2.02	.030	.12	.49	3.67	....	36,500	1.0	170	E
4-13-43	1.8	...	.18	1.5	1.83	.01	.038	.30	3.77	....	47,500	5.5	139	D
3-17-34	3.3	...	.14	2.0	2.15	.01	.037	.31	3.63	....	55,000	5.8	149	D
437-3	0.75	.25	.05	1.5	3.27	<.005	.053	.20	3.59	.001	64,750	6.0	167	B
443-2	0.75	.25	.05	1.5	3.25	<.005	.042	.21	3.66	.002	64,000	6.0	163	B
L-42-4	0.75	.25	.05*	3.0	3.97	.004	.54	.41	3.29	....	60,800	...	228	C
BD-2	0.75	.25	.06‡	1.5	2.06	.012	.108	.52	3.96	....	57,400	1.5	187	E
L-39-4	1.00	.25	.05*	1.5	2.59	.009	.49	.40	3.60	....	40,000f	...	228	C
L-46-4	1.00	.25	.037	1.5	2.91	.012	.40	.44	3.30	....	48,200	...	217	C
53-813	1.30	.44	.022	1.5†	2.66	.021	....	...	3.80	X	51,500	6.0	156	F
58-808	1.35	.45	.09	1.5	2.70	.018	....	...	3.80	X	53,600	5.5	153	F
53-811	1.58	.53	.05	1.5†	2.65	.032	....	...	3.83	X	51,900	7.5	146	F
L-43-4	1.50	.25	.05	3.0	3.54	.004	.46	.43	3.42	....	72,000	...	269	C
L-68-3	1.78	.25	.16#	1.5	2.29	.010	.60	.50	3.48	....	77,600	1.0	255	C

f—Flawed bar *—T-compound ‡—Mischmetal †—85% FeSi
X—Mg not detected by wet method
#—0.05% REO + 1.5% FeSi containing 3.7% Ce

A—Basic cupola D—Electric furnace
B—Laboratory induction E—Acid cupola
C—Neutral cupola F—700-lb. induction

TABLE 7—EFFECT OF VARYING LATE FERROSILICON ADDITION ON UPGRADED PROPERTIES OF BASIC INDUCTION MELTED-CARBIDE TREATED IRON

Heat No.	Treatment, lb./ton CaC_2	MgO	FeSi	Chemical Analysis TC	Si	Mn	S	P	Mg	Tens. Str., psi	BHN	Elong., % in 2 in.
435-1	..	..	10	4.10	1.73	.227	.014	.027	.....	12,780	90	....
435-2	..	..	20	4.00	2.18	.225	.014	.027	.....	11,620	87	....
435-3	..	..	40	3.87	3.07	.223	.015	.026	.....	12,930	85	....
435-4	15	5	10	4.11	1.73	.224	<.005	.028	.004	28,900	125	....
435-5	15	5	20	4.01	2.34	.218	<.005	.028	.0036	45,000	143	....
435-6	15	5	40	3.58	3.02	.219	<.005	.030	.0036	56,900	169	....
436-1	..	..	10	3.83	2.45	.199	.015	.027	.....	15,750	98	....
436-2	..	..	20	3.71	2.93	.199	.014	.028	.....	15,300	95	....
436-3	..	..	40	3.61	3.69	.200	.014	.032	.....	12,250	98	....
436-4	15	5	10	3.83	2.48	.198	<.005	.041	.0046	24,900	111	....
436-5	15	5	20	3.77	2.90	.196	<.005	.040	.0046	43,300	156	....
436-6	15	5	40	3.51	3.77	.195	<.005	.039	.0032	65,000	179	....
471-1	..	..	18	3.09	1.84	.55	.064	.095	.....	43,400	199	....
471-4	..	..	80	2.87	4.75	.53	.059	.088	.....	16,650	110	....
471-6	30	..	40	3.21	2.98	.55	<.005	.090	.....	52,700	187	....
471-7	30	..	60	3.16	3.90	.53	<.005	.087	.....	55,600	192	....
471-8	30	..	80	3.07	4.82	.52	<.005	.083	.....	69,200	220	....
473-4	..	..	60	3.82	4.62	.24	.024	....	.....	19,600	107	....
473-6	15	..	20	3.87	2.99	.20	.004	....	.....	33,800	114	....
473-7	15	..	40	3.68	4.21	.23	.005	....	.....	72,600	170	11.5
473-8	15	..	60	3.90	4.96	.23	.006	....	.....	92,600	217	6.0

TABLE 8—EFFECT OF ANNEALING ON PROPERTIES OF CARBIDE TREATED IRONS

Heat No.	Treatment, lb./ton CaC_2	MgO	NiMg*	REO	FeSi	Mg Analysis	Heat Treatment	Tens. Str., psi	BHN	Elong., % in 2 in.
376-2	30	..	..	..	10	....	not treated	30,100	128	..
376-2	30	..	..	..	10	....	treated	56,800	149	7
380-2	60	..	..	..	10	....	not treated	39,350	129	2
380-2	60	..	..	..	10	....	treated	62,200	149	10
381-3	30	..	..	..	30	<.001	not treated	41,900	167	2
381-3	30	..	..	..	30	<.001	treated	73,400	178	21
436-4	15	5	..	..	10	.0042	not treated	24,900	111	..
436-4	15	5	..	..	10	.0042	treated	55,900	129	6
394-3	15	10	..	..	30	....	not treated	47,250	146	..
394-3	15	10	..	..	30	....	treated	74,000	159	17
383-4	30	5	10	..	26	.029	not treated	65,000	174	7
383-4	30	5	10	..	26	.029	treated	78,800	171	10
393-4	30	..	20	..	20	.051	not treated	65,000	170	6
393-4	30	..	20	..	20	.051	treated	74,850	159	19
443-2	15	5	..	1	30	.002	not treated	64,000	163	6
443-2	15	5	..	1	30	.002	treated	73,000	159	11

* 2 NiMg alloy

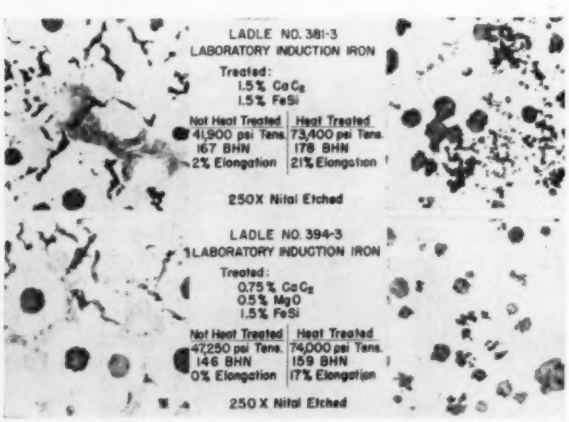


Fig. 14—Comparison of treated irons cast in 1-in. keel blocks (left) and cast as 5/8-in. chilled specimens subsequently given a short-cycle anneal. See Table 8 for results obtained with various treating agents.

cold calcium carbide and nitrogen will lower the temperature of the molten metal, so that a sufficiently high temperature is necessary in order that a satisfactory pouring temperature may be obtained after treatment.

Four-Way Division

The process may be divided into four fields as follows:

1. Desulphurizing from 0.10-0.20 per cent sulphur to 0.07-0.08 per cent sulphur—In this range of conventional desulphurization, calcium carbide injection offers a means of control within narrow limits and savings in refractory cost. Under normal conditions, ten pounds of calcium carbide injected will remove one pound of sulphur.

2. Desulphurizing from 0.10-0.20 per cent sulphur to less than 0.02 per cent sulphur—Calcium carbide injection makes possible reduction of sulphur to lower levels than conventional desulphurizing agents and permits use of more economical alloy additions for high strength cast irons because of the reduction in

chill accompanying calcium carbide treatment of cast iron. An example of this would be the substitution of ferrochrome for the more expensive ferromolybdenum or ferrovanadium in the manufacture of a class 40 or class 45 cast iron.

3. Desulphurizing to less than 0.02 per cent suphur as a base metal for conversion to spheroidal graphite cast iron—By using a base iron of very low sulphur there is a savings in spheroidizing alloy since it is not consumed in removing the sulphur. There is evidence that less residual magnesium is required to obtain satisfactory spheroidal graphite cast iron from iron previously treated with calcium carbide mixtures. There is a reduction in carbide forming tendency of spheroidal graphite cast iron made from iron treated with calcium carbide.

4. To upgrade physical properties and spheroidize by injecting calcium carbide or a mixture of calcium carbide and other spheroidizing impelling agents—It is possible under some conditions to upgrade irons of low tensile strength to tensile strengths as high as 92,000 psi having fully spheroidized graphite by injecting calcium carbide and rare earth oxides. It is also possible to manufacture irons of 40,000, 50,000, 60,000, 70,000 and 80,000 psi tensile strength containing different percentages of spheroidized graphite by variations in the spheroidizing impelling agents. These agents consist of calcium carbide, magnesium oxide, rare earth oxides, magnesium alloys, etc.

Acknowledgment

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3. H. E. Henderson & P. M. Hulme, *Foundry*, vol. 81, no. 4, April 1953, p. 86.

Committee Invites Cost Questions

QUESTIONS on specific foundry cost problems will be answered at a Cost Session of the 58th Annual Meeting of AFS in Cleveland, May 8-14. Foundrymen seeking practical answers by experts on the Cost Committee are invited to send their questions promptly to: Ralph L. Lee, Chairman, AFS Foundry Cost Committee, c/o Grede Foundries, Inc., Box 443, Milwaukee. The 1954 question-and-answer session on foundry costs is expected to be one of the most interesting and informative staged by the Committee in view of rising interest in cost accounting, stimulated by current business conditions and some of the newer production methods.

The Foundry Cost session at the Convention has been scheduled for Thursday, May 13, at 2 pm. Here is an excellent opportunity to obtain expert advice.

Round Table Questions — Brass and Bronze Division

THE Round Table Luncheon of the Brass and Bronze Division, to be held at noon, Tuesday, May 11, 1954, at the AFS Convention in Cleveland, will again feature a question period. In order to facilitate the discussions, the questions are listed here in advance:

1. Why don't test bars cut from castings have the same properties as those obtained from separately cast test bars?

2. What is the effect of chemical variation within a casting on the mechanical properties?
   a. What is the cause of this variation?
   b. Are all copper-base alloys similarly affected?
      (1) Red brasses (low shrink)
      (2) Al-Mn bronzes (high shrink)

3. What effect does cooling rate have on segregation and mechanical and physical properties?

4. If metal is gassed due to a heavy slag cover while melting and this cover is removed on subsequent heats and high quality metal is then obtained, will excessive shrinkage result in this latter metal?
   a. How do you determine the quality of the metal?

5. What problems are encountered in melting and casting the high tensile bronzes?
   a. Aluminum bronzes
   b. Manganese bronzes
   c. Silicon brasses

6. What merits are to be obtained when superheating copper-base alloys?

7. What fundamental facts about combustion should the foundryman know to achieve high quality metal?

8. Does the melting crucible enter into the gas reaction in the metal?

9. What are the economics involved in the casting of copper-base alloys in the following:
   a. "D" Process
   b. "C" Process
   c. High pressure molding

10. What beneficial or detrimental effects do the minor elements have on the copper-base casting alloys?
   a. Sulphur
   b. Aluminum
   c. Hydrogen
   d. Carbon
   e. Sodium
   f. Potassium
   g. Silicon

11. Why aren't synthetic sands used more extensively than natural bonded sand in the molding for brass and bronze alloys?

Establishing Standards For As-Cast Surfaces

ROY A. LODER / *Chief Inspector, Erie Malleable Iron Co., Erie, Pa.*

Duplicating the casting finish desired by the customer from order to order is possible when easily-understood standards are established. Written discussion of this paper, Convention Preprint No. 54-18, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Sand Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ Use of the word *finish* in this paper refers exclusively to as-cast or rough casting surfaces.

One of the problems in a jobbing foundry is the successful duplication of the methods used to produce good castings each time a job is run. Jobbing foundries often have thousands of customers' patterns, many of which are run as infrequently as once a year or longer. This poses the problem of remembering how a job was made previously and what standards of inspection were acceptable at that time.

Many foundries have resolved this difficulty by the use of a job record system, the purpose of which is to record information on how the job was run the last time and serve as a guide for subsequent runs. Job record cards give such information as mold hardness, type of sand, pouring temperature, and surface finish desired. When it comes to describing finish, the foundryman faces a problem as this element is probably more susceptible to erroneous or "convenient" memory than any other factor connected with making a job or judging the quality of the casting.

Finish Production Vital

Reproduction of an acceptable finish is a vital matter since it is this feature of a casting that is most apparent not only to the customer of the foundry but also to the purchaser of the end-product containing the casting. Some types of castings become the most conspicuous component of an end-product. One example is hand tools sold at retail over the counter where casting surface is subject to critical inspection by the consumer. Castings of this nature generally require an

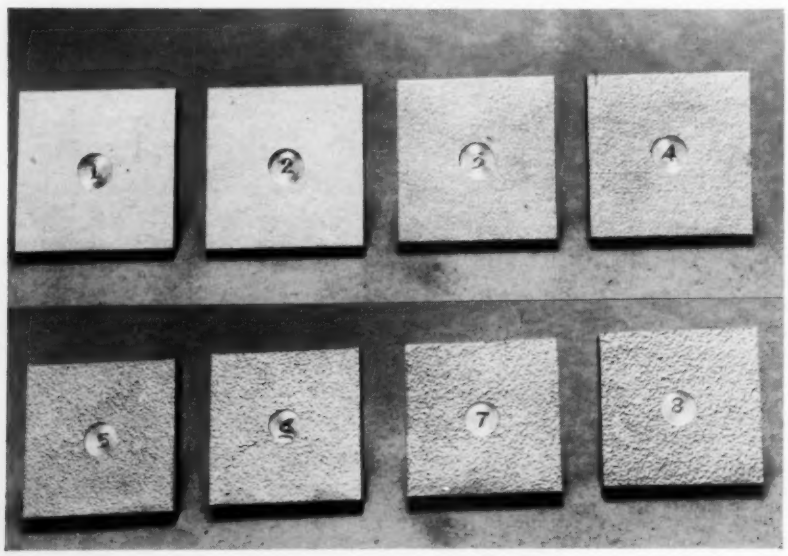

Fig. 1 (above)—Casting finish comparison standards, numbers 1-4.
Fig. 2 (below)—Coarser casting finishes designated by numbers 5-8.

especially good surface finish. The question is: "How *good* a surface?"

Many attempts have been made to measure casting surface finish in some way and to establish standards. A surface indicator with a very small point is not convenient for obvious reasons. A comparator is objectionable for the same reason as the surface indicator. The need is for a tool for rough shop use and not for a laboratory instrument. Sometimes sample castings representative of the desired finish have been saved for long periods of time in order to serve for visual comparison with later production. This, however, poses problems of storage and while satisfactory for a few jobs, would never do for large quantities.

Sandpaper Not Durable

In a search for a reasonably invariable medium of comparison, the thought occurred that various grades of sandpaper might be the answer. However, sandpaper as such was impractical due to its lack of durability. It was apparent that if the sandpaper surface could be transferred to a permanent block of some kind, it would have durability and be easy to handle. This was accomplished by casting sandpaper surfaces in various grades on aluminum blocks which now serve permanently for visual comparison with casting surfaces. Blocks were arbitrarily numbered for reference.

The mechanics of making the aluminum comparison blocks turned out to be simple. Eight grades of sandpaper were selected: 4/0, 3/0, 2/0, 0, 1/2-60 grit, 1/2-40 grit, 1-40 grit, and 1-1/2-40 grit. These grades cover the range of finish on castings produced. Eight patterns 2¼ in. square by ¼ in. thick were made and on one side of each was glued a grade of sandpaper cut to the square of the pattern.

All eight patterns were then mounted on the cope side of a pattern plate and the mold was hand rammed. Great care was taken to ram the mold uniformly. Of considerable importance was the molding sand which was No. 00 Albany, selected due to its fine texture and ability to reproduce the minute detail of the patterns. The pattern was drawn without rapping or vibrating. Fear that some degree of back-draft under the grains of sand on the sandpaper might preclude a proper draw proved to be unwarranted.

Aluminum was chosen for the blocks to take advantage of its lightness and because it was felt that there would be a minimum of mold swell and metal penetration. The fluidity of the high-silicon pattern alloy made it possible to produce castings unusually true to pattern. The eight finished test blocks are shown as Fig. 1 and 2. The numbers 1 to 8 were stamped on after casting. For the purpose of conserving the surface of the inspection blocks and faciliate handling in service, they were mounted in wood and covered with lucite as shown in Fig. 3.

Slow Acceptance

As is often the case with new ideas, initially the standard surface finish comparison blocks met with some skepticism. However, acceptance was not long in coming as the blocks provided a simple, reliable way of identifying the finish on a casting and facilitated the permanent recording of that finish.

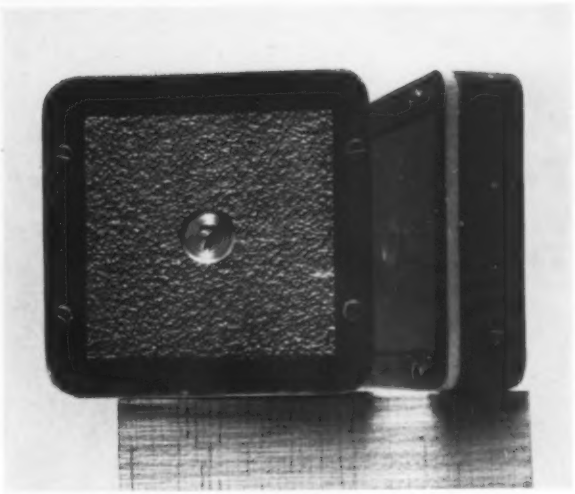

Fig. 3—Casting finish standards, mounted in wood and protected with transparent plastic cover.

When new jobs are sampled, an effort is made to produce a finish commensurate with the type and use of the casting and the requirements of the customer. This information is given to the foundry in terms of the Finish Number corresponding to the comparison block of that number. Through experience with established sand mixes and molding methods, the foundry is able to choose the proper sand and facing and ram the mold so as to produce the desired finish. After the customer has approved the sample castings and the job goes into production, a Job Record Card is written which includes the Finish Number.

The most obvious advantage of the surface comparison blocks is the elimination of guesswork and arguments about what the finish was when the job was last made. By having an established standard to work to, the customer is assured of a minimum of variation in the finish of castings he buys. The foundry is spared the cost of returned and scrapped castings and the expense of producing a finish that in some cases might be unnecessarily good for a particular job.

Exceptions Overcome

Exception might be taken to the number of blocks involved and the fact that there is very little difference in surfaces of adjacent blocks. This can be overcome by making finishes equivalent to alternate blocks thus having only four blocks and a more pronounced difference in surface from one to the next. Obviously, if other standards are required, appropriate grades of sandpaper can be used thus giving unlimited flexibility of adaptation to the surface standards of any foundry.

A word of warning should be voiced in connection with the preparation, casting, and mounting of the aluminum blocks. Having failed to make clear the purpose of the whole project to one of the workmen in the shop and in an effort to make a nice fit of the lucite protective covering, he disced off the critical surface entirely and ended up with a perfectly smooth block nicely protected but entirely useless!

★ 1954 Convention Preprint

Heat Transfer Characteristics of Metals Cast in Shell Molds

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Solidification characteristics of metals cast into shell molds with backup are similar to those of sand castings. Without backup, differences dependent on specific conditions may develop. Written discussion of this paper, Convention Preprint No. 54-63, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Heat Transfer Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ It has been demonstrated[1,2] that the nature of solidification of metals may be varied by changes in the mold material which markedly affect the rate of heat transfer from casting to mold. For example, steel solidifies in wide band* fashion when cast in sand molds and in narrow band fashion when cast in chill molds. On the other hand, changes in the types of sand, moisture content, grain size, etc., have no discernible effect on the mode of solidification. The same relative effects have been demonstrated for a variety of other metals. In general, a change in solidification rates involving decreasing solidification time to 0.1-0.2 of the original value is required to change wide band (mushy) solidification to narrow band solidification; conversely a change from narrow band to wide band solidification involves increasing solidification times in the order of 5- to 10-fold.

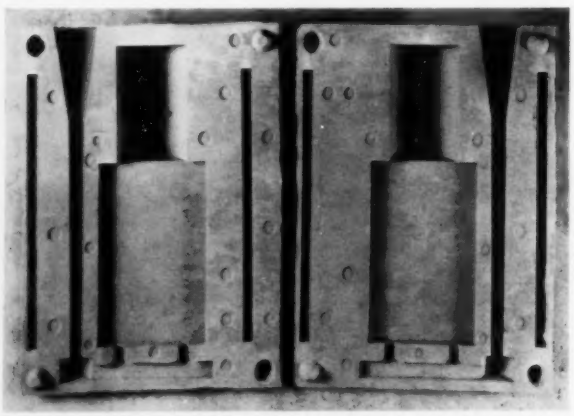


Fig. 1—Shell mold halves for test plate castings.

In essence, this means that the type of solidification which is characteristic of a given metal cast in a sand mold is not changed by variations of sand or molding practices. This is fortunate for otherwise the foundry characteristics (feeding requirements, shrinkage behavior, etc.) which are related to the specific solidification characteristics of the different metals would be highly variable.

With this background, it is of interest to investigate the thermal characteristics of shell molds with respect to conventional sand molds. As a basic premise, the foundry characteristic of a given metal cast in sand molds and shell molds should be expected to be the same or different depending on whether moderate or drastic changes in solidification rates result from the change in molds. That is to say, steel or bronze cast in shell molds should behave in the same manner as steel or bronze cast in sand molds, provided that drastic differences in solidification rates are not developed and vica versa.

This investigation was aimed at establishing data of comparative heat transfer characteristics of shell molds in comparison to sand molds for a variety of metals. The effects of variations in shell mold practice, particularly with respect to mold thickness and backup material were of particular interest.

Experimental Procedures. The test castings used for these studies were plates of ½, ¾, 1 and 1½ inches in thickness and widths equal to five times the thickness. The gating and risering details may be deduced from the shell molds shown in Fig. 1. The risers were deliberately made oversize (Diam. = 3 times plate thickness) to insure adequate flow of feed metal and the elimination of under-riser shrinkage.

The shells were made with an AFS No. 150 washed sand containing 7 per cent resin. The mold assemblies were clamped together with staples, then placed in

*The terms *narrow band* and *wide band* used to describe the type of wall growth are equivalent to the usual but more cumbersome terms *highly* and *slightly progressive wall growth.*

TABLE 1—METAL ANALYSIS AND POURING TEMPERATURE

	C	Si	Mn	Pouring Temp.
Steel	0.24	0.60	0.80	2900 F
Nodular Iron, High CE	3.35	2.53	0.40	2500 F
Nodular Iron, Low CE	2.90	2.11	0.33	2500 F
	Cu	Zn	Sn	Al	
G Bronze	89.1	2.7	8.2	—	2000 F
Aluminum	4.7	—	—	95.3	1300 F

metal containers (Fig. 2) and backed either with $\frac{1}{16}$-in. diameter steel shot, or with a coarse sand having ar AFS fineness number of 5.2. To insure that the molds would not be deformed by the pressure of the liquid metal, the backup material was compacted by means of a small air vibrator attached to the container. The sand molds were made with an AFS No. 80 sand bonded with 3.0 per cent western bentonite, 1.5 per cent dextrin, 0.5 per cent corn flour and containing 3 per cent water. Figure 3 presents grain size distribution curves for the mold and backup materials.

Cooling curves were obtained using techniques described in previous reports[2,3]. The thermocouples were placed at the geometric center of the plates. The alloy compositions and pouring temperatures of the metals which were investigated are listed in Table 1.

Solidification Rates. The cooling curves obtained for the various metals cast in sand and shell molds are presented in Fig. 4 to 7. The various curves are grouped to illustrate specific effects related to thickness of the casting, shell thickness, backup material and interrelations of these effects. The following may be deduced in comparison to the rates of solidification in sand molds:

1. FIXED THICKNESS OF PLATE — SHELL THICKNESS AND BACKUP VARIED. Figures 4A, 5, and 7 illustrate that an appreciable decrease in solidification time is obtained only for the case of thin shells backed with shot. The effects become more pronounced as the shell thickness is reduced. The effect of gravel backup is very small even for the case of thin shells. Shells used without backup show a marked increase in solidification time.

2. FIXED THICKNESS OF SHELL AND BACKUP — CASTING THICKNESS VARIED. Figures 4B, 6A, 6B, and 7 illustrate that for ¼-in. shells (least practical thickness) the effect of shot backup becomes more pronounced as the thickness of the casting is increased. In other words the important variable is the ratio of shell thickness to plate thickness.

Calculate Percentage Decrease

These qualitative observations may be reduced to more quantitative terms by calculating the percentage decrease in solidification time for the various cases as a function of the shell thickness to casting thickness ratio. Table 2 presents the calculations and Fig. 8 the graphical plots. All times were noted to the nearest half minute, which approaches the limit of accuracy of the thermal data. The various total times and time differences involved were such that calculated percentage differences of less than 5 per cent may be considered of doubtful significance. Bearing this in

Fig. 2—Shell mold assembled and backed up.

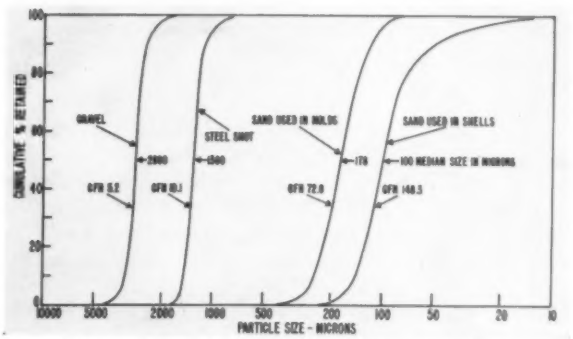


Fig. 3—Grain distribution of backup materials.

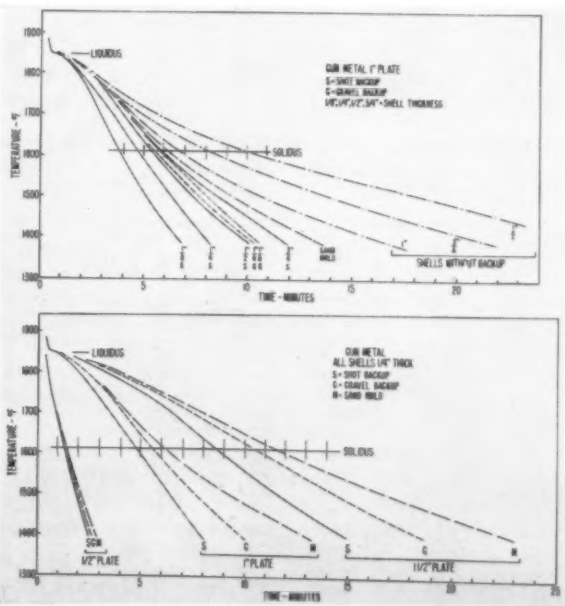


Fig. 4a (upper) and 4b (lower)—Effect of varying shell thickness (upper) and plate thickness (lower) on solidification of gun metal.

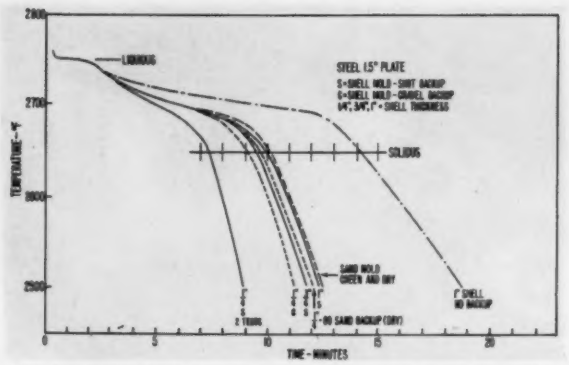


Fig. 5—Solidification and cooling curves for steel cast in shells of varying thickness.

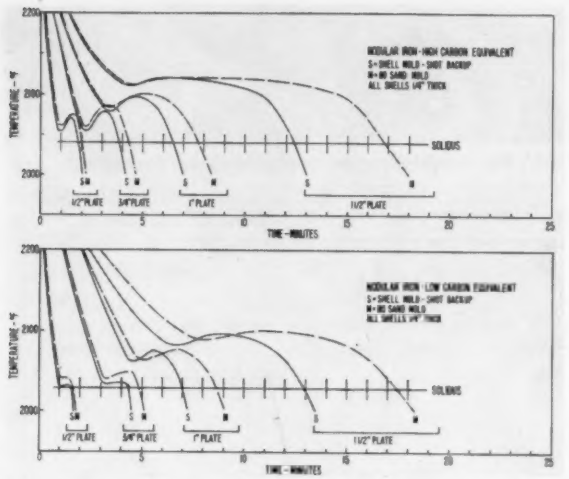


Fig. 6a (upper) and 6b (lower)—Influence of backup material on solidification of nodular iron.

mind, it may be deduced from Fig. 8 that a significant decrease in solidification time is obtained only if the shell thickness is less than 0.5 of the casting thickness. As the shell thickness approaches an absolute practical limit of 0.1 to 0.2 of the casting thickness, a maximum

TABLE 2—DECREASE IN SOLIDIFICATION TIME SHELL VS. SAND MOLD

Metal	Thickness Plate in.	Thickness Shell in.	Backup	Shell to Plate Thickness Ratio	Decrease in Solidification Time Compared to Sand Mold (Min.)		Per Cent
Bronze	1½	¼	Shot	0.17	—3	(11.5)	—26
			Gravel	0.17	—1		—9
	1	¼	Shot	0.25	—1.5	(6)	—25
			Gravel	0.25	—.5		—8
		⅛	Shot	0.125	—2.3		—38
			Gravel	0.125	—.5		—8
		½	Shot	0.50	—.5		—8
		¾	Shot	0.75	0		0
Steel	1½	¼	Shot	0.17	—3.0	(10)	—30
			Gravel	0.17	—1.0		—10
		¾	Shot	0.50	—.5		—5
	1		Shot	0.67	0		0
Aluminum	1½	¼	Shot	0.17	—5.0	(18)	—27
			Gravel	0.17	—1.5		—8
		½	Shot	0.33	—2.5		—14
		¾	Shot	0.50	—.5		—3
	1	¼	Gravel	0.25	—.5		—3
Nodular (H.C.)	1½	¼	Shot	0.17	—5.0	(17)	—30
	1	¼	Shot	0.25	—1.5	(7.5)	—20
	¾	¼	Shot	0.33	—.5	(4.5)	—11
Nodular (L.C.)	1½	¼	Shot	0.17	—5.0	(17.5)	—28
	1	¼	Shot	0.25	—2.0	(8.5)	—23
	¾	¼	Shot	0.33	—.5	(5.0)	—10

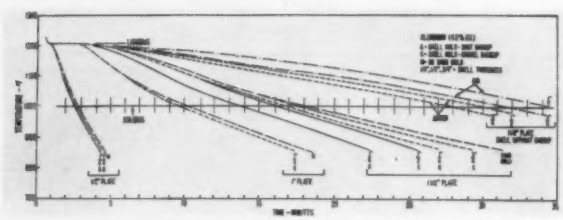


Fig. 7—Solidification of aluminum plates cast in shells of varying thickness.

decrease in solidification time of 30 to 40 per cent is obtained for shot backup and approximately 10 per cent for the case of gravel backup.

The observations of the relative effects of shot and gravel backup are in keeping with the relative heat transfer characteristics of these two materials. Compared to conventional molding sand, gravel has higher conductivity when heated to temperatures of visible red heat. However, the differences in heat transfer compared to sand are only moderate when compared in turn to that of a chill material. The higher rates of heat transfer of the backup material (moderately higher for gravel and markedly higher for shot) cannot be utilized until the shell heats through to a high temperature. Thus, the effects of the backup material depend on the thickness ratio of shell to casting inasmuch as this factor determines the time during the solidification of the casting (early or late) that the backup material is brought into action.

Faster Solidification with Shot

The effect of the shot backup is limited to 30-40 per cent decrease in solidification time, compared to a 80-90 per cent effect possible by direct application of a chill,[1,2] because the shell acts as a heat valve. No matter how potent the heat extraction ability of the backup material, the limiting condition of heat transfer is determined by the conductivity of the thin layer of sand which separates the casting from the chill material. The insulating characteristics of sand are further demonstrated by the fact that at shell thickness ratios of 0.5 and greater the chilling effects of the shot backup are almost entirely suppressed. It should not be assumed, however, that the shot and/or the gravel backup materials are rendered completely inactive by shell thicknesses of 0.5 to 0.75 ratios. The cooling curve data for shells cast without backup indicate that such is not the case.

Figures 4A, 5 and 7 show that the elimination of the backup material for shells of 0.5 to 0.75 of the casting thickness results in a pronounced increase in solidification time (40 per cent for steel, 70 per cent for gun metal, and 80 per cent for aluminum when compared to sand molds). In the case of steel and gun metal, active burning occurred on the outside surfaces of the shells due to the ready availability of oxygen. Inasmuch as such burning was confined to the surface of the backup material (no burning next to shell) when backup is used it may be suspected that the increase in solidification time is due in part to the external heating of the shells by the flames.

For the case of aluminum there was no visible burning and the only possible heating effect was one

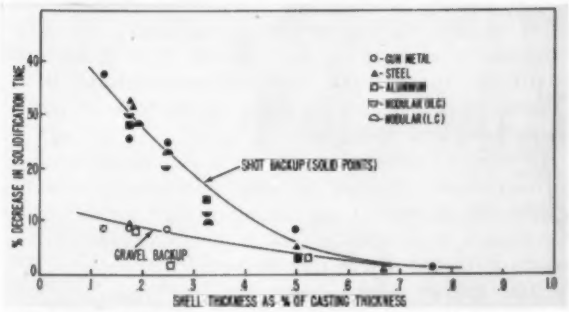


Fig. 8—Solidification time of shell mold castings in relation to sand mold casting solidification time.

of slow combustion within the shell itself. To isolate the heating effect due to burning, two shells were poured with a surrounding atmosphere of argon so as to exclude atmospheric oxygen. Comparison of the solidification curves of the castings poured with and without the argon atmosphere, Fig. 7, shows only a small decrease in solidification time when burning (if any) was prevented. Obviously, the difference in solidification times for the 1½-in. plate with a ¾-in. shell (0.5 ratio) cast with shot backup and without backup (argon atmosphere) must be ascribed to heat removal by the shot backup. In other words, while chilling effects were suppressed by the shell (0.5 ratio) the shot backup nevertheless contributed to heat removal. The action of shot or gravel backup for shells of 0.5 to 0.75 ratio is thus recognized as being essentially equivalent to a thick overlay of sand — if absent the heat storage capacity of the system is inadequate and solidification is delayed.

Near Solidification Time

As shown by Fig. 4A (1-in. bronze plate with 1-in. shell, no backup) at a ratio of 1.0 the shell approaches a thickness of adequate heat storage capacity as indicated by a close approach to the solidification time in a sand mold. It is also observed that as the shell thickness ratio is reduced below 1.0 the solidification time for shells without backup increases in regular fashion. This should be expected inasmuch as the heat capacity of the system is reduced proportionally to the reduction of the thickness ratio.

It is difficult to assess accurately the contribution of the active surface combustion observed for the case of steel and gun metal to the increase in solidification time for shells without backup. In the case of steel very intense burning occurred for approximately two-thirds of the solidification time of the casting; in the case of bronze, burning was less intense but lasted during the entire time of solidification. Obviously the interface temperatures of the various metals, thickness of shell, amount and type of binder, etc., must have complex interacting effects on rates of heat generation from the combustion process.

Figure 9 presents shell surface temperature data for various conditions. For the case of aluminum which showed no visible burning, the surface temperature increased gradually after an initial delay required for the movement of heat through the shell. Steel and bronze showed rapid temperature rise without an initial delay due to the surface flame — within 0.5

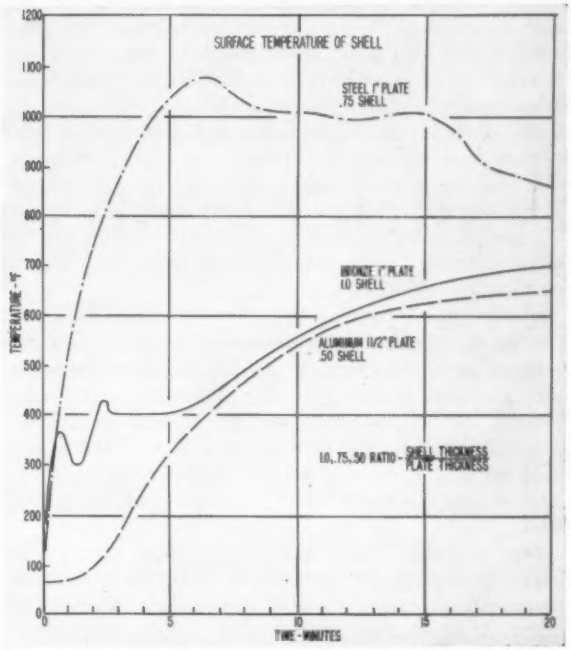

SURFACE TEMPERATURE OF SHELL
STEEL 1" PLATE .75 SHELL
BRONZE 1" PLATE 1.0 SHELL
ALUMINUM 1½" PLATE .50 SHELL
1.0, .75, .50 RATIO - SHELL THICKNESS / PLATE THICKNESS
TEMPERATURE - °F
TIME - MINUTES

Fig. 9—Temperature rise of shell surface for castings poured without backup.

minute the surface temperature was approximately 400 F for each case. In the case of bronze the surface temperature stabilized at approximately 400 F for approximately 5 minutes indicating that the opposing effects of surface heating and movement of heat into the shell from the surface achieved a temporary balance. As the shell gradually heated through, the surface temperature began to rise in the usual uniform fashion. In the case of steel a drop in surface temperature is indicated at approximately 7 minutes which corresponded to an abatment of the surface flames.

From a practical viewpoint it may be generalized that regardless of the activity of surface combustion, castings poured in shell molds of practical thickness ratios (0.25 to 0.75) should solidify at slower rates than for the case of backup. The difference may be roughly in the order of 3- to 4-fold increase in solidification time compared to shot backup for the case of 0.25 shells and 1.5- to 2-fold increase for the case of 0.75 shells. The activity of surface combustion probably modifies the increases within the limits noted.

Comments on Solidification Mode. While solidification diagrams (start and end of freeze curves) for the progression of freezing through the thickness of the castings were not obtained, it is possible to approximate the shape of the diagrams from considerations of the cooling curves for the center of the castings. The time interval between the start and end of freeze at the center indicates whether a change in solidification mechanism occurred. It may be noted in the case of steel, bronze, and aluminum that variations in shell mold practice have no measurable effects on the time at which the start of freeze occurs at the center and that the time is the same as observed for sand molds. The end of freeze developed at the center follows the variations which have been described for the com-

pletion of solidification (same point). Thus, for the case of shells with backup the differences in time between the start and end of freeze at the center are so small as to rule out any significant changes in solidification characteristics except for the case of shells of very low thickness ratio. Even in the most extreme case of low thickness ratio shells (decrease solidification time 30-40 per cent) there is no change in mechanism — the change merely involves a minor decrease in solidification band width of steel and a minor decrease in the delay of developing a solid skin for aluminum and bronze.

If the end of freeze point in sand is compared to that in the various shells poured without backup the changes involve increasing the time interval between start and end of freeze of the order to 2- to 3-fold. This is an appreciable change (again of degree) which involves an increase in the width of the solidification band for steel and a marked increase in the delay of developing a solid skin for aluminum and bronze.

The nodular irons follow the same pattern as described above. An additional observation may be made: the eutectic reaction temperature is lowered as the casting thickness is decreased, however the effect of shot backup per se is essentially nil. The thickness of the casting and not the type of backup establishes the eutectic reaction temperature. It is possible that this may not hold for the case of shells poured without backup.

In view of these observations it is concluded that no significant changes in foundry characteristics of metals should result from casting in shell molds which are backed by shot or gravel. A possibility exists that pouring in open shells may aggravate the difficulty of feeding metals which feature a long delay in the development of a solid skin because the unfavorable features of this type of freezing are enhanced. Investigations are underway to check these implications.

References

1. H. F. Bishop and W. S. Pellini, "Solidification of Metals," *Foundry*, vol. 80, no. 2, pp. 86-93, 253, 254, 255, 256, 257, 258, 259, 260, 261, February 1952.

2. F. A. Brandt, H. F. Bishop and W. S. Pellini, "Solidification of Various Metals in Sand and Chill Molds," AFS PREPRINT No. 54-62.

3. E. T. Myskowski and H. F. Bishop, "Foundry Applications of High Temperature Immersion Thermocouples," AMERICAN FOUNDRYMAN, vol. 23, no. 4, April 1953, pp. 150-155.

Calendar of Future Meetings and Exhibits

April

5-7 . . American Institute of Mining & Metallurgical Engineers
Palmer House, Chicago. National Open Hearth Conference.

8-9 . . Malleable Founders' Society
Pittsburgh, Pa. Market Development Conference.

12-15 . . Society of Automotive Engineers
New York, Spring Aeronautical Meeting.

14-16 . . Society for Experimental Stress Analysis
Netherland Plaza Hotel, Cincinnati. Spring Meeting.

20-21 . . American Zinc Institute
St. Louis. Annual Meeting.

24-May 9 . . 6th Liege International Fair
Liege, Belgium

26-28 . . Metal Powder Association
Chicago. Annual Meeting.

26-28 . . Chamber of Commerce of the United States
National Chamber Building, Washington, D. C. Annual Meeting.

26-30 . . American Society of Tool Engineers' Industrial Exposition
Convention Center, Philadelphia.

May

2-6 . . Electro Chemical Society
Chicago. Spring Meeting.

3-5 . . Air Pollution Control Association
Patten Hotel, Chattanooga, Tenn. Annual Meeting.

4-7 . . American Welding Society
Hotel Statler, Buffalo. National Spring Technical Meeting.

5-7 . . American Society of Training Directors
Schroeder Hotel, Milwaukee. Annual Conference.

5-8 . . American Welding Society
Buffalo Memorial Auditorium, Buffalo. Welding and Allied Industry Exposition.

8-14 . . AFS Convention & Exhibit
Public Auditorium, Cleveland.

12-14 . . Porcelain Enamel Institute
Chicago. Midyear Divisional Meeting.

16-19 . . Industrial Furnace Manufacturers Association
The Homestead, Hot Springs, Va. Spring Meeting.

17-20 . . Basic Materials Conference & Exposition
International Amphitheatre, Chicago.

June

9-11 . . American Society for Quality Control
Hotel Jefferson, St. Louis. Annual Convention and Exhibit.

13-18 . . American Society for Testing Materials
Hotels Sherman and Morrison, Chicago. Annual Meeting.

14-15 . . Malleable Founders' Society
Seigniory Club, Quebec, Canada. Annual Meeting.

July

13-15 . . Western Plant Maintenance Conference & Show
Pan Pacific Auditorium, Los Angeles.

September

13-25 . . First International Instrument Congress & Exposition
Philadelphia Convention Hall, Philadelphia, Pa.

19-26 . . Associazione Italiana di Metallurgia
Florence, Italy. 21st International Congress of Foundry Technical Associations.

27-28 . . Steel Founders' Society of America
The Greenbrier, White Sulphur Springs, W. Va. Fall Meeting.

October

6-8 . . National Foundry Association
La Salle Hotel, Chicago. 56th Annual Meeting.

14-15 . . Michigan Regional Foundry Conference
Ann Arbor, Mich.

14-16 . . Foundry Equipment Manufacturers' Association
The Greenbrier, White Sulphur Springs, W. Va. Annual Meeting.

27-29 . . Grinding Wheel Institute & Abrasive Grain Association
Edgewater Beach Hotel, Chicago. Fall Meeting.

November

1-5 . . National Metal Congress, National Metal Exposition
Palmer House, Chicago.

11-12 . . Gray Iron Founders' Society
The Homestead, Hot Springs, Va. Annual Meeting.

December

1-4 . . American Institute of Mining & Metallurgical Engineers
Hotel William Penn, Pittsburgh, Pa. Electric Furnace Steel Conference.

Pouring Temperature Effect on Steel Castings

C. F. CHRISTOPHER / *Director of Research, Continental Foundry & Machine Co., East Chicago, Ind.*

The temperature relationship between the freezing casting surface and the molten core of the casting determines susceptibility to porosity. **Written discussion of this paper, Convention Preprint No. 54-57, should be sent to American Foundrymen's Society, 616 South Michigan Ave., Chicago 5, Ill. The paper will be presented at a Steel Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.**

■ Temperature of the steel, as it enters the mold, has far reaching effects because it either controls or strongly influences the following major factors:

1. For any given mold size or design, the temperature of the steel entering that mold influences the pattern of solidification. The influence of the steel temperature on the cooling effect of the mold surface is a major factor in selective freezing, which is a part of the mechanism of porosity formation.

2. The temperature of the steel entering the mold controls the strength of the deoxidizers present and indirectly the oxygen level at that time.

3. When the steel enters the mold and begins to freeze on the mold wall, it is the pouring temperature-deoxidizer influence on oxygen that determines the susceptibility to both porosity and iron sulphide precipitation.

Salability Precludes Porosity

All steel castings must be made free from porosity to produce a salable product. All steel must, therefore, be deoxidized sufficiently to overcome all conditions which lead to the carbon monoxide gas reaction.

Regardless of carbon content or degree of deoxidation, every heat of steel, as it leaves the pouring nozzle, is either at equilibrium or below. It is impossible to produce any heat of steel which is sufficiently out of equilibrium to produce a gaseous reaction in the ladle. In other words, as soon as a heat of steel is tapped into the ladle, the introduction of oxygen into the steel ceases and the steel becomes dead and inactive. This is true whether a deoxidizer has been added or not. An 0.08 per cent carbon rimming steel with practically no deoxidation will be as inactive in the ladle as any dead-killed steel.

Another important fact is that all steels, regardless of whether they are deoxidized or not, will remain quiet in the ladle regardless of temperature as long as the steel is completely above the liquidus temperature. This substantiates the thermodynamic fact that carbon controls the maximum oxygen that any steel can hold and that this carbon-oxygen equilibrium holds, regardless of steel temperature.

Temperature Controls Strength

Even though a carbon-oxygen reaction cannot occur in the ladle, the temperature at any given time in the ladle controls the strength of deoxidizers which may be added or present. Therefore, when a ladle of steel is being poured into a mold the oxygen level at that time is established by the amount of deoxidizer added and the relationship of that deoxidizer to the temperature. The strength of the deoxidizer weakens as the pouring temperature rises until the oxygen content reaches the maximum carbon-oxygen level attainable. Any further pouring temperature increase will not effect a further oxygen increase.

Every ladle of steel, therefore, is at equilibrium when it enters the mold at any given temperature. In order for that heat of steel to give porosity, the

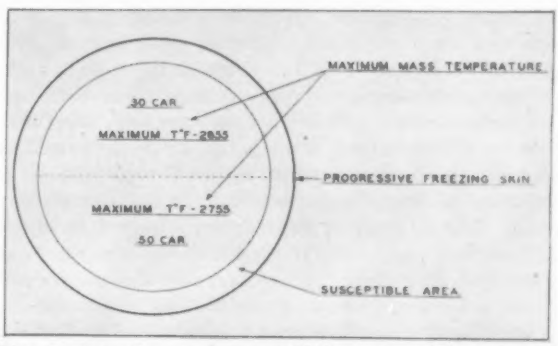


Fig. 1—Location and susceptibility of solidifying steel to develop porosity.

reaction of $2C + O_2 \rightleftarrows 2CO \uparrow$ must be disturbed by the addition of either carbon or oxygen.

The only source of disturbance is carbon being set free during the freezing period. This selective freezing, with consequent precipitation of excess carbon, takes place quickly along the mold wall while the body of the casting and the steel being poured is still at a much higher temperature. It is the temperature relationship between the freezing mold surface and the temperature of the rest of the casting that determines susceptibility to porosity.

If the temperature in the center of the casting is high, the deoxidizers are weak, resulting in a high iron oxide content. Under such conditions, if the skin is freezing and throwing out carbon, porosity will form in the metal adjacent to the skin unless a strong deoxidizer is used.

Deoxidization Necessary

It is necessary to deoxidize the steel sufficiently to offset the tendency for porosity to form in the mold surface area. Increasing the carbon in this area upsets the equilibrium between carbon and iron oxide and causes the excess carbon to react with the higher iron oxide already present. This tendency increases as the body of the metal increases in temperature and decreases as the body temperature decreases. This occurs because the deoxidizers only lower the oxygen with decreased temperature.

Therefore, there is extreme danger of over-deoxidizing the mass of metal in a casting in order to sufficiently deoxidize the surface to eliminate porosity by selective freezing and precipitation of carbon.

Figure 1 shows diagrammatically the tendencies existing in all solidifying steel masses. The carbon being thrown out along the solidifying surface tends to throw this area out of equilibrium with the original iron oxide present. The absence of selective freezing in the center while this area is cooling keeps this metal under the carbon-oxygen equilibrium and consequently free from porosity.

Figure 2 is a photograph of a 0.28 per cent carbon casting deoxidized with 0.30 per cent silicon. Location of the porosity shows the marked effect of carbon-iron oxide disturbance at the freezing surface. Slightly increasing the deoxidation of this steel would make the center completely sound with all the porosity in the surface area. By progressively increasing the deoxidation, the surface area porosity would diminish until the entire casting was free from porosity. If the temperature were increased with this same deoxidation, porosity would begin to re-appear in the surface area, requiring greater deoxidation to again remove it.

Efforts to counteract surface area porosity must take into consideration the temperature-deoxidizer content relation which produces iron sulphide precipitation in the mass of metal as it cools down to the freezing point. The amount of deoxidizers required to eliminate surface porosity at their high-temperature, weak state will deoxidize too strongly as the mass cools down, since they gain in strength as the steel cools.

Selective freezing is natural to all steels. An examination of the iron-carbon diagram shows the tremendous amount of carbon set free as various carbon steels

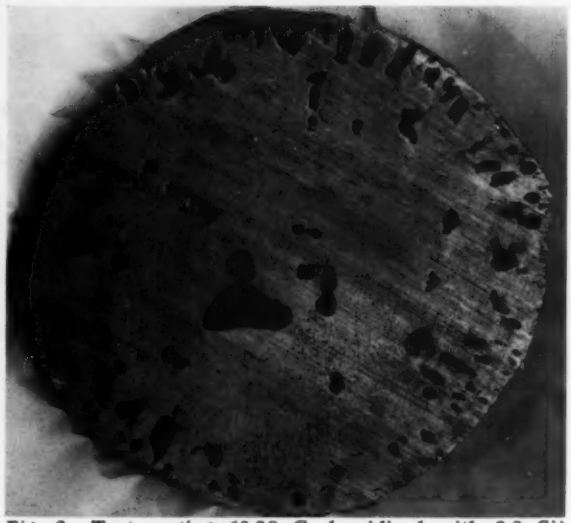


Fig. 2—Test casting (0.28 C deoxidized with 0.3 Si) showing porosity around casting surface. Slight increase of deoxidation would produce sound center, concentrate porosity in surface area. Entire casting would be freed of porosity through progressive increase of deoxidation.

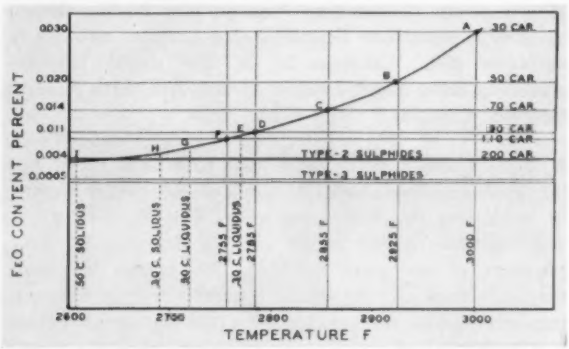


Fig. 3—Relation between pouring temperature and iron oxide content in steels deoxidized with 0.4 per cent silicon. Curve interprets theoretical equilibrium conditions and practical application.

freeze through the liquidus to the solidus. More important than selective freezing is the temperature of the adjacent metal which determines its deoxidation strength with deoxidizers present. Not only is it important to understand why porosity and iron sulphide (over-deoxidation) occur, but it is also important to apply the knowledge to actual operating practice.

Figure 3 is a diagrammatic relationship of pouring temperature to iron oxide. This curve is an interpretation of theoretical equilibrium conditions and a practical application of that work to actual practice. This figure shows the following:

1. Curve A-1 indicates the effect of 0.40 per cent silicon on iron oxide between 2600 F and 3000 F. At any temperature shown in the figure, there is a corresponding iron oxide content for 0.40 per cent silicon.

2. By transferring the equilibrium of carbon-iron oxide on to this chart, it is possible to determine the combined effects of carbon and silicon at various temperatures.

3. This curve shows the permissible pouring temperature with 0.40 per cent silicon, the permissible

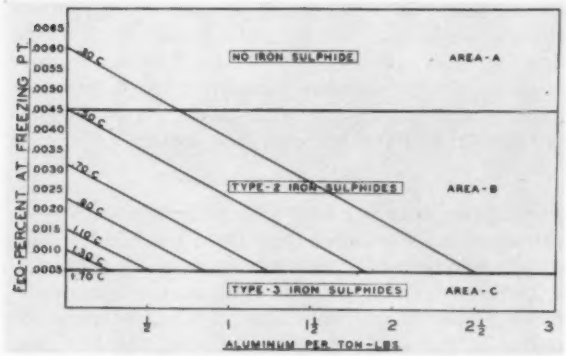


Fig. 4—Aluminum required for various carbon contents to control sulphide inclusion formation.

selective freezing which can take place at any pouring temperature, whether aluminum has to be added in addition to 0.40 per cent silicon, and whether the steel will contain iron sulphides when it cools to the freezing point.

In a 0.40 per cent silicon steel poured at 3000 F the equilibrium iron oxide content will be 0.030 per cent. The equilibrium content for 0.30 per cent carbon is also 0.030 per cent iron oxide, the carbon and silicon lines intersecting at point *A*. This means that, at 3000 F pouring temperature, 0.40 per cent silicon will be ineffective in removing iron oxide.

If this steel enters the mold at 3000 F and begins to freeze on the mold wall, porosity will form immediately. A 0.30 per cent carbon steel can segregate up to 0.70 per cent carbon in the liquid metal adjacent to the freezing surface. Enough aluminum or other strong deoxidizer would have to be added to destroy the iron oxide differential between 0.30 per cent carbon and 0.70 per cent carbon (or the exact amount of carbon segregated). The carbon-enriched liquid metal would be in equilibrium with much less iron oxide than that originally existing with 0.30 per cent carbon and would react at 3000 F unless aluminum or some other strong deoxidizer was added.

As the mass of steel cooled from 3000 F to 2690 F (the approximate solidus for a 0.30 per cent carbon steel) the silicon would increase in deoxidizing power along the silicon curve *A* to *H*. When this steel has cooled down to the solidus it will contain 0.006 per cent iron oxide unless enough aluminum has been added to take it below this value.

Silicon Controls Iron Oxide

By selecting a lower pouring temperature, 2925 F, the silicon is effective enough to lower the iron oxide from 0.030 per cent to 0.020 per cent (*B*). If the carbon segregates to 0.70 per cent it can be seen that porosity will still develop with less aluminum required to produce soundness.

As the mass of steel cools, the effectiveness of the silicon will follow the line *B* to *H*, and again finish at 0.006 per cent iron oxide in spite of the lower pouring temperature. If aluminum is added it may or may not alter this amount depending upon the the amount added.

If a 0.30 per cent carbon steel containing 0.40 per cent silicon is poured at 2855 F, theoretically it should have no porosity and certainly will be safe at lower temperatures. Segregation up to 0.70 per cent carbon is possible, but it is unsafe and unwise to pour at this temperature or above without aluminum additions.

The author has checked these pouring temperatures carefully and finds that 2825 F is the safest operating temperature on a 0.30 per cent carbon, 0.40 per cent silicon steel. The final iron oxide content will be approximately 0.006 per cent regardless of the pouring temperature. This percentage will not be lowered unless enough of any other stronger deoxidizer is added.

Figure 3 is an effective, practical chart for setting up maximum pouring temperatures for all carbon steels. It is useful in calculating aluminum additions to either avoid porosity, Type 2 sulphides, or both at any pouring temperature. It shows the maximum carbon content which can be poured with silicon deoxidation alone without incurring iron sulphide inclusions.

Higher Carbon Steels. Higher carbon steels cannot produce as much porosity as low carbon steels, but are far more susceptible to porosity formation. They segregate carbon to a much greater extent along the freezing casting surface and, therefore, require stronger deoxidation and lower pouring temperatures or both.

A 0.50 per cent carbon, 0.40 per cent silicon steel is interesting to consider due to the fact that it is the maximum carbon content that can be poured with silicon deoxidation alone. When this carbon grade cools to the solidus temperature, 2615 F, 0.40 per cent silicon lowers the iron oxide to approximately 0.0045 per cent. This is the critical iron oxide level at which iron sulphides precipitate.

Porosity Susceptibility

Furthermore, a 0.50 per cent carbon steel is extremely susceptible to porosity due to the large amount of carbon precipitation resulting from selective freezing. Up to approximately 1.10 per cent carbon segregation can take place which means that the maximum pouring temperature can be about 2750 F. As shown in the chart, the silicon will reduce iron oxide in a 0.50 per cent carbon steel from 0.020 per cent to 0.0091 per cent at 2750 F. It can be seen that a 1.10 per cent carbon segregate also containing 0.0091 per cent iron oxide equilibrium will not react. Also it can be observed that a 0.50 per cent carbon steel cannot be poured above 2750 F without porosity unless some aluminum is added.

If size of product permits and proper temperature control facilities are available all practices which permit the precipitation of iron sulphides should be avoided. As described in this paper, this is only possible on steels from 0.50 per cent carbon down. This is the maximum carbon due to the fact that with normal 0.40 per cent silicon deoxidation, this steel will freeze at the maximum permissible iron oxide content which will avoid iron sulphide precipitation.

To avoid porosity in lower carbon steels deoxidized with 0.40 per cent silicon, requires certain maximum pouring temperatures. The proper pouring temperature for any carbon steel can be calculated from the

chart. Examples are given for 0.30 per cent and 0.50 per cent carbons which call for 2855 F and 2750 F temperatures respectively.

Not all companies are able to pour steels under 0.50 per cent carbon at the low temperatures specified, due to many conditions—main reasons being small castings or long pouring times. Increasing the temperature over that specified above means porosity unless the resulting weakening of the silicon is compensated for by aluminum or other stronger deoxidizers.

On steels below 0.50 per cent carbon, required amounts of aluminum which will compensate for the silicon and still avoid iron sulphide inclusion precipitation can be calculated from the chart. For example, a 0.30 per cent carbon steel with 0.40 per cent silicon poured at 3000 F would contain 0.030 per cent iron oxide. The minimum iron oxide permissible in any steel is 0.0045 per cent. The difference (must be removed by aluminum) is 0.0255 per cent which can be calculated to pounds of aluminum required. This is not a safe practice, naturally, and most operators prefer to add large amounts of aluminum to such steels and produce Type 3 sulphides.

However, many shops use small amounts of aluminum to avoid porosity but not enough to reduce the iron oxide below 0.0045 per cent, where iron sulphides begin to form.

Above 0.50 per cent carbon, porosity should not be a problem with anyone. All such steels contain Type 2 sulphides and aluminum or other strong deoxidizers should be used to avoid this condition. If strong deoxidation is not resorted to, the steel will not only contain Type 2 sulphides but may also contain porosity unless poured at a very low temperature.

Over-deoxidation. The first portion of this paper refers primarily to the surface of the freezing casting and concerns the formation and elimination of porosity in that area. This is important, because what is done to eliminate porosity on the surface, controls the metallurgical quality of the central mass and this controls what deoxidation practice is finally required.

Assuming that how to deoxidize sufficiently to eliminate porosity is known, it is also essential to know what is going to happen when the steel cools down to the solid casting. The iron oxide content, when porosity forms, is far different from what it is when the casting freezes many degrees later in the cooling cycle. Knowledge of what could happen and what to do about it must be available before the heat is tapped.

Iron Oxide Content

Table 1 shows the calculated iron oxide contents for a large number of carbon steels before they are deoxidized and also at their freezing point after 0.40 per cent silicon deoxidation. This table also shows the relationship of iron oxide content to the formation of iron sulphide (Types 2 and 3) inclusions. As indicated, a low level of iron oxide causes the precipitation of iron sulphide inclusions.

By taking a large number of samples from the bath on various high carbon steels with no deoxidation, it is found that chain type sulphides appear at about 1.30 per cent carbon or 0.0077 per cent iron oxide. Unfortunately it is impossible to pour these samples without porosity forming, and consequently losing some of the iron oxide present. If these samples could be poured without porosity, Type 2 iron sulphides would not appear until before about 1.90 per cent carbon or 0.005 per cent iron oxide.

Freezing Points Differ

By adding 0.40 per cent silicon to extremely high carbon steels, it is found that Type 3 sulphides form at approximately 1.70 per cent carbon or approximately 0.0005 per cent iron oxide. This occurs because the freezing point of iron sulphides (2187 F) is above the solidus of the steels. Any steel above 0.50 per cent carbon deoxidized with 0.40 per cent silicon, or lower carbon steels which must be poured over a given temperature, must be deoxidized with aluminum or another deoxidizer stronger than aluminum.

Aluminum Practice. It is necessary to set up a practice for aluminum additions which will be adaptable to all shops and types of practices. This practice should be designed to avoid Type 2 iron sulphides on steels under 0.50 per cent carbon which may be poured at various temperatures due to size of product, and on higher carbon steels at any desired temperature.

Figure 4 shows oxide content (plotted against pounds of aluminum per ton) of various carbon content steels killed with 0.40 per cent silicon at their freezing point. The parallel lines indicate the effect of

%Carbon	FeO Equilibrium	Solidus Temp°F	Inclusion Type	.040 Si/FeO Equilib. at Solidus Temp	Inclusion Type
030	00333	2688		00060	
050	00200	2615		00046	FeS–Type II
070	00143	2550		00032	"
090	00111	2490		00023	"
110	00090	2420		000166	"
130	00077	2350	FeS	000115	"
150	00067	2280	"	000078	"
170	00059	2200	"	000051	II + III
190	00054	2120	"	000034	"
210	00047	2066	"	000026	"
230	00044	"	"	"	"
250	00040	"	"	"	"

Table 1—Iron Oxide Content and Relationship to Iron Sulphide Inclusions.

adding increased aluminum to these steels. They also show the amount of aluminum required to produce Type 2 inclusions at the critical 0.0045 per cent level and the amount required to further lower the iron oxide to the Type 3 level, 0.0005 per cent, to avoid Type 2 inclusions.

Area *A* represents low carbon steels, below 0.50 per cent, and shows that it is possible to make these steels either with no aluminum or with small controlled amounts and avoid Type 2 inclusions. This will depend upon the temperature of pouring and whether or not porosity can be controlled with silicon alone and no aluminum or with the corresponding small amounts shown.

Area *B* shows that Type 2 chain inclusions will form on low carbon steels if a critical amount of aluminum is added, or on high carbon steels unless an excess is added.

Area *C* represents Type 3 inclusions which will

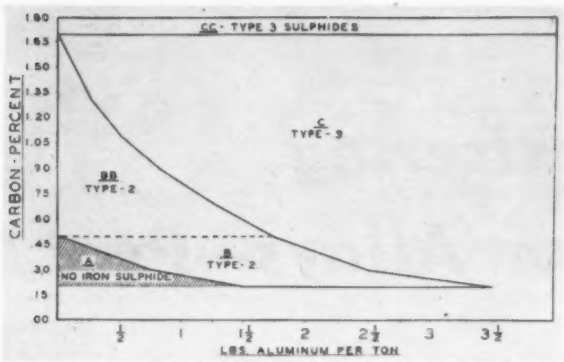


Fig. 5—Shop deoxidation chart showing aluminum to be added to steels of various carbon contents.

result in all steels if enough aluminum is added to produce a residual amount.

Figure 5 is a practical deoxidation chart simplified for use in the shop. It sets up a practice and designates the inclusion types as follows:

1. Area *CC*—On steels above 1.70 per cent carbon, the sulphides approach Type 3 with silicon alone and no special deoxidation is required for this purpose.

2. Area *BB*—Aluminum must be added to steels from 0.50 per cent to 1.70 per cent carbon equal to or exceeding the amounts designated by the curve. These steels with silicon alone produce Type 2 inclusions and must be further deoxidized to Type 3 as designated.

3. Area *A*—This area represents low carbon steels where it is possible to produce a product with no iron sulphides, either by silicon alone or by strict control of aluminum additions.

Low Temperature Pouring

On 0.50 per cent carbon no aluminum can be added in order to avoid iron sulphide precipitations which means that the control of porosity will depend entirely upon low temperature pouring. If the product does not permit low temperature pouring, enough aluminum must be added to produce Type 3, as shown.

As the carbon drops below 0.50 per cent, increasing amounts of aluminum can be safely added without the formation of Type 2 inclusions.

On very low carbon steels, very large amounts of aluminum can be added without danger of Type 2 inclusions.

4. Area *B*—Amounts of aluminum shown in this area should always be avoided. Either small amounts, if pouring temperature permits, or large amounts if pouring hot, should be used as shown.

5. Area *C*—Aluminum should always be added to steels in this area above 0.50 per cent carbon or on lower carbon steels if low pouring temperatures are inadvisable or unavoidable.

Conclusions

This paper is a practical interpretation of theoretical equilibrium conditions taking place at the pouring temperature and during the freezing cycle in the mold. It deals with the resulting oxygen levels and their relationship to the type of inclusion formed, as well as methods and practices used to rectify bad inclusion types or avoid them.

The largest percentage of steel castings is made with 0.20 to 0.50 per cent carbon. Furthermore, more and more castings are required to meet physical properties and are being required to compete with wrought steels. Unfortunately, quality in 0.20 to 0.50 per cent carbon contents is difficult to make under all conditions. Low temperature pouring control is a problem in intricate or small castings, although it permits the best deoxidation practice for high physicals.

High-temperature pouring automatically leads to detrimental deoxidation practices in order to avoid porosity. These circumstances naturally lead some foundries into expensive deoxidizers and rectifiers such as calcium, cerium, titanium, calcium-manganese-silicon, cerium oxide, lan-cer-amp, and many others.

Some foundries deoxidize with silicon alone, avoid porosity, and produce excellent properties. Other foundries use silicon and aluminum to accomplish the same purpose. Still other foundries use all the deoxidizers mentioned above. Over-doing or under-doing the deoxidation either hurts the steel or the pocket book or both. There is a correct way to make steel and there is no substitute for knowing the facts so that better steel can be made at the lowest cost.

A.S.A. Publishes New Standards

AMERICAN Standards Association, Inc., has completed a list of all standards adopted during 1953. Those applicable to the metals casting field are listed below. Price lists and further information are available by writing American Standards Association, Inc., 70 E. 45th St., New York 17.

Standard	Title
A21.3-1953	Specifications for Cast Iron Pit Cast Pipe for Gas
A21.6-1953	Specifications for Cast Iron Pipe Centrifugally Cast in Metal Molds for Water or Other Liquids
A21.7-1953	Specifications for Cast Iron Pipe Centrifugally Cast in Metal Molds for Gas
A21.8-1953	Specifications for Cast Iron Pipe Centrifugally Cast in Sand-Lined Molds, for Water or Liquids
A21.9-1953	Specifications for Cast Iron Pipe Centrifugally Cast in Sand-Lined Molds for Gas
A21.11-1953	Specifications for a Mechanical Joint for Cast Iron Pressure Pipe and Fittings
B16.23-1953	Cast-Brass Solder Joint Drainage Fittings
B16.24-1953	Brass or Bronze Flanges and Flanged Fittings 150 and 300 Lb.

When inquiring, include the standard number and the full title. Standards applicable to other industrial fields are also available upon request.

★ 1954 Convention Preprint

Gating and Risering of Magnesium Alloys—Part I

H. E. Elliott / *Metallurgist, Dow Chemical Co., Bay City, Mich.*

Casting defects caused by faulty gating and risering can be minimized using the techniques developed by suppliers of magnesium alloy aircraft castings. Written discussion of this paper, Convention Preprint No. 54-42, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Light Metals Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ The most important usage of magnesium alloy sand castings has been in the aircraft industry. Here designers have sought to achieve maximum strength combined with minimum weight; hence, highest quality levels have been a necessity in the great majority of the applications. The following discussion of the gating and risering of magnesium alloy castings is intended to be of interest primarily to the foundryman who is required to produce castings containing the fewest possible casting defects. Scant attention will be given to the short-cuts which are possible where quality can be compromised. This paper will deal chiefly with casting defects that have their origin in faulty gating and risering practice, and the principles that can be applied to avoid them.

The casting process can be divided for purposes of study into two stages: mold-filling stage for solidification stage. Certain common casting defects have their origin in the mold-filling stage. These include (1) misruns and cold-shuts, and (2) non-metallic inclusions, such as entrapped dross, air bubbles, and seams. Another large class of common casting defects have their origin in the solidification stage. These may be termed the shrinkage defects, and include (1) visual shrinkage defects, such as shrinks and draws, (2) microporosity, (3) cracking, and (4) warpage.

Avoidance of defects that occur in the mold-filling stage of the casting process lies largely in the practices employed in the gating or running of the casting. Avoidance of defects that occur in the solidification stage lies in the risering or feeding of the casting. It is convenient to discuss these two phases of the casting problem separately.

Gating. Inasmuch as the first requisite to the production of a sound casting is the complete filling of the mold with clean, inclusion-free liquid metal, the mold-filling stage of the casting operation may logically be discussed first. Normally, the filling of a mold involves the transfer of a body of clean liquid metal from a container positioned above the mold to a position of rest within the mold cavity.

The fundamental problems are (a) to achieve complete filling of the casting cavity before the metal has frozen, and (b) to retain the cleanliness and freedom-from-inclusions of the metal in the process of transferring it. These problems are more difficult with magnesium alloys than they are with many other alloys because of the low heat content of liquid magnesium, because of its low specific gravity, and because of its high chemical reactivity. At first, consider the problems associated with the preservation of the cleanliness of the liquid metal in its transfer from the pouring crucible to its final position of rest within the casting cavity.

Gating Turbulence. Anyone who has worked with molten magnesium has observed the rapid oxidation that occurs when a fresh liquid surface is exposed to the atmosphere. In the transfer of liquid metal from a compact body above a mold to the final position of rest within the mold, it is inevitable that a great deal of fresh liquid surface will be exposed to reaction with surrounding atmospheres. A condition giving rise to turbulence anywhere in the gating system, resulting in the churning up of mold gases with liquid metal, can readily be seen to result in a maximum exposure of new liquid metal surfaces for reaction.

Protective Atmosphere

Molding sands for magnesium alloys contain inhibitors that generate a protective atmosphere within the mold. It is necessary to understand, however, that these protective vapors do not operate by preventing reaction between metal and mold atmosphere. They operate by the formation of *protective films*. When a protective film forms on a freshly exposed liquid metal surface, it protects the metal beneath from further reaction. If, however, this protective film is promptly stirred into the body of the liquid metal, exposing fresh surfaces for reaction, as is the case where

flow-turbulence is involved, severe drossing of the metal will occur.

Turbulent flow of a reactive metal is bound to produce a mixture of the liquid metal with films or skins of the product of the reaction between the metal and the mold gases; there may also be a quantity of unreacted mold gases associated with this mixture. The result is the generation of a foam of dross which tends to be carried along with the stream of metal in much the same way that a foam of suds is generated by turbulent motion of soapy water.

Characteristics of Dross. The mixture of metal and skins and unreacted gases which forms as a result of gating turbulence is light; it tends to rise and float on the surface of the metal stream when it comes to a state of rest or quiet flow. Examination of the runner of almost any magnesium alloy casting will reveal evidence of this foamy dross on the cope surface of the runner, close to the base of the sprue. It is noted that farther and farther from the sprue-base, less and less of this dross is detectable, and far enough away, a fracture of the runner will indicate complete cleanliness.

This dross is light; it floats easily on liquid magnesium; it lodges readily against the cope surface of the runner, allowing clean, skimmed-off metal to flow beneath. An understanding of this behavior of dross provides valuable tools for controlling it and preventing it from entering the casting cavity. The first task in gating a magnesium alloy casting is to visualize the conditions in the filling of the mold that may give rise to the formation of dross; and then to devise means of suppressing its formation or preventing it, once formed, from entering the casting.

The importance of the problem of gating turbulence has received recognition, and a good deal of experimental work has been devoted to achieving a better understanding of how to avoid defects arising from this source. The work of Mezoff and Elliott[1] demonstrated that mold gases can be aspirated into the stream of metal flowing through sprues of certain designs. An AFS-sponsored research project conducted at Battelle Memorial Institute demonstrated a variety of gating conditions that could lead to entrainment of mold gases, and explored methods of avoiding these conditions.[2, 3, 4]

Prevention of Dross Inclusions. There are two basic approaches to the prevention of dross inclusions in the casting: (a) Complete suppression of dross formation, as by totally avoiding turbulence of flow in the transfer from pouring crucible to casting cavity; (b) The separation of dross from the stream of metal prior to its entry into the casting cavity.

Present gating practice for casting magnesium alloys is based primarily on approach *b*. The problems associated with completely avoiding gating turbulence, at the relatively high flow rates required in the filling of commercial castings, have not been solved. A number of interesting principles have been established showing how to alleviate design conditions that promote entrainment of mold gases in the metal stream. No general solution has been presented, however, by which the foundryman can design a complete, integrated sprue-runner-gate system of general applicability. Such a system would succeed at any desired pouring rate in completely avoiding air entrainment throughout the pour, while delivering the desired volume flow of metal at the desired locations into the casting cavity.

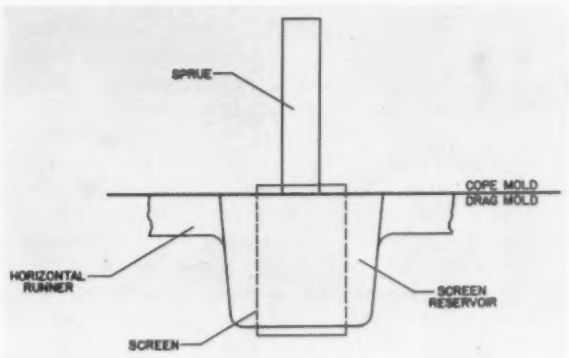


Fig. 1—Common magnesium alloy gating practice with vertical screen at base of sprue to hold back dross.

It is conceivable that further research will provide a general solution to this problem. It is likely that any general solution arrived at would be quite complex, due to the many complicating factors that are introduced by specific design characteristics of the particular part.

If a practical general solution to the problem of completely avoiding gating turbulence were made available, it is not at all certain that it would be the most economical approach to elimination of dross inclusions in the casting. Such a solution, to gain acceptance, would have to be competitive with the second approach to the avoidance of inclusions—the separation of entrained dross from the metal stream prior to the entry of the metal into the casting cavity.

Commercial Practice for Avoiding Dross Inclusions. Up to the present time, gating practice for magnesium has been based largely on this latter approach. In using this approach, it is assumed that a certain amount of turbulence in the first part of the gating system can be tolerated. The fact is accepted that this turbulence will generate a certain amount of dross, which must be separated from the metal stream before the metal enters the casting. In using this approach, it is of paramount importance to recognize that turbulence must be confined to the first part of the gating system, and that in no case can turbulence be tolerated within the casting cavity itself. Recognition of this necessity leads to two principles which may be regarded as the starting point of a sound gating system:

1. The metal cannot be allowed to cascade from one level in the casting cavity to a lower level; this means that the metal must enter the casting cavity at its lowest level, and that the cavity must be caused to fill progressively from the bottom upward.

2. The metal must not be allowed to spurt or squirt into the casting cavity through restricted gates. Excessive linear velocity of the metal at the ingates leads to turbulence at this point, and results in the formation of inclusions which are entrapped in the casting. There must be a smooth, quiet flow of metal through

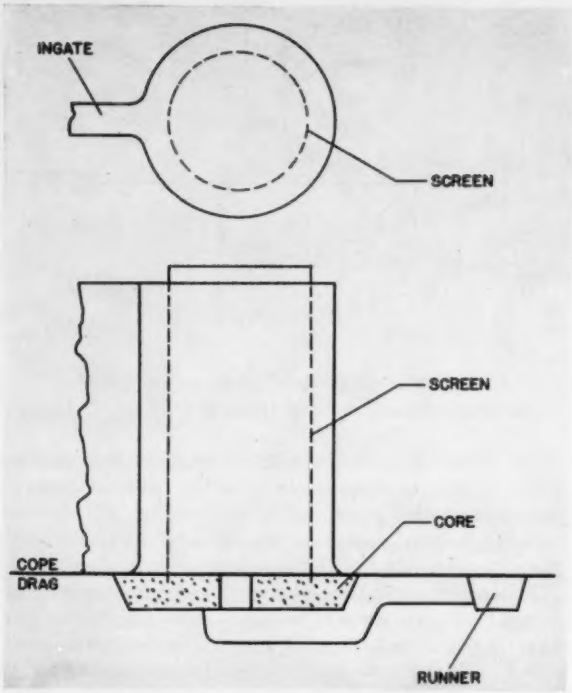


Fig. 2—Cylindrical screen provides larger total area for metal passage, giving non-turbulent flow.

each ingate. Therefore, if a rapid filling of the casting is desired, there must be ample total ingate area to ensure that excessive linear velocities are not produced at any individual ingate.

A good way (and a very common way) of achieving this condition is to control the filling rate of the casting near the beginning of the gating system. Usually, the sprue is made the controlling member, or choke, in the gating system. Subsequent channels of the runner system are made of ample cross-sectional area to carry off freely all the metal that the sprue will deliver.

Full Drop in Sprue

The full vertical drop of the metal to bring it to its lowest position in the mold occurs in the sprue. Thereafter, the metal flows horizontally or upward only. From the base of the sprue onward it is essential to avoid in every way excessive linear velocities of the metal stream. In the author's experience, a good rule to follow is: Make the total cross-section of the channels leading from the base of the sprue about double the sprue cross-section; make the total ingate area into the casting cavity also at least double the sprue cross-sectional area. Adherence to this practice seems to effectively avoid formation of dross in the horizontal runner and at the ingates.

This practice narrows the drossing problem down to one of effectively separating from the metal stream the dross that has been formed in the pouring cup, in the down-sprue, and at the sprue-base, thereby delivering clean metal to the latter portions of the runner system. Practical and effective ways of doing this are available. The methods used vary from foundry to foundry. The techniques found most effective at the author's foundry will be discussed.

Separation of Dross from the Metal Stream. To separate from the metal stream the foamy dross which has formed in the sprue and at the sprue-base, reliance is placed on two principles: (1) Employment of strainers or filters, usually at the base of the sprue; and (2) Taking maximum advantage of the relative lightness of the dross, and of its tendency to float on liquid magnesium alloys, and of its capacity to be skimmed off of the upper surface of a level, quietly-flowing stream of metal.

Figure 1 illustrates a very common practice. A reservoir containing a vertical screen is located at the base of the sprue. (Screen material consists of perforated, tin-plated, steel sheet. Most commonly used type is made of 0.010-in. material. Diameter of each perforation is 0.050 in., total percentage of void area is about 28 per cent. Terne-plated material may also be used. Diameter of the perforations and their spacing may also be varied.) The metal from the sprue is introduced inside the screen and must pass through it before entering the horizontal runner leading to the casting ingates. The screen serves a dual purpose. First, it serves to filter out dross that has formed in the sprue; second, it serves to moderate the high linear velocity that the metal has acquired in its fall down the sprue, promoting quieter flow of metal in the horizontal runner after it leaves the sprue base.

The first metal to enter the screen reservoir is likely to be sprayed out through the holes of the screen, with the exposure of a large amount of fresh liquid-metal surface for reaction with mold gases. To limit the duration of this shower-spray effect, it is desirable to fill the screen reservoir as quickly as possible. As soon as the screen reservoir is filled with metal inside and outside the screen, the screen becomes an effective filter, and a spraying effect whereby many small streams of metal are exposed to mold gases no longer prevails.

To ensure that the screen reservoir will fill as rapidly as possible and then stay full throughout the pour, it is desirable to place it at a level in the mold below the subsequent channels and cavities into which the metal flows. If the screen reservoir is the lowest cavity in the mold, it will naturally fill completely before metal is available to any other cavities. Once the screen reservoir is full both inside and outside the screen, a quiet seepage of the metal through the screen and thence into the horizontal runner is realized.

Sprayed Streams

However, the very first metal passing through the screen does not flow through under such ideal conditions. As above noted, it is likely to be sprayed through the screen in the form of many tiny streams, affording much opportunity for formation of dross. Provision must be made to prevent any dross so formed from entering the casting.

Such provisions are based on the relative lightness of this dross, and its strong tendency to be floated to the upper surface of a still pool or of a quietly-flowing stream of magnesium alloy. Advantage can be taken of this property of the dross in the placement and positioning of the horizontal runner and ingates. Whenever possible, the horizontal runner

leading from the screen reservoir is placed lower in the mold than the casting cavity. (In practice, this usually means that the runner is molded in the drag and the casting in the cope or cheek.) This practice results in the complete filling of the horizontal runner before any metal begins to enter the casting cavity.

Measures taken to promote quiet flow in the runner have already been discussed. Any dross that may have formed when the first-poured metal sprayed through the yet-unsealed screen is now floated to the cope surface of this completely-filled runner. It is found that the dross lodges against this cope surface, allowing clean, skimmed-off metal to flow beneath. It is desirable to avoid placing the first ingates into the casting too close to the screen reservoir. This allows time and distance for the flotation-skimming action to become completely effective. If extremely high pouring rates are employed on a particular casting, resulting in high linear velocity of the metal in the runner, a correspondingly longer distance must be allowed between the screen reservoir and the first ingates into the casting.

Various foundries have arrived at different solutions to the problem of keeping dross out of the casting. In one foundry, it is the practice to place the horizontal runner partly in the cope and partly in the drag, with the ingates leaving the runner at the parting line. Another foundry molds the horizontal runner entirely in the cope, with the ingates drawing metal from the bottom of the runner. Some foundries are reported to avoid the use of screens in the running system; these foundries are said to resort to double runner systems consisting of two or more concentric horizontal runners, with staggered gates leading from outside runner to inside runner, and from inside runner to casting, thus allowing time and distance for dross to be floated and skimmed off before the metal enters the casting.

The fact that various solutions are found effective is evidence that the drossing problem need not be a seriously limiting problem in the casting of magnesium alloys. Though it is an important problem requiring attention if maximum quality levels are desired, it can be solved by intelligent application of rather simple principles. Practical solutions are in every day use that do not require the complete avoidance of all gating turbulence. It is necessary, though, that turbulence be confined to the first part of the gating system, and that provision be made to effectively separate from the metal the dross that results from such turbulence.

Design of Sprues and Runner Cups. Some foundries give considerable attention to the exact design details of the first part of the gating system, such as the runner box and the sprue. In some shops, batteries of slot-shaped sprues are used. In other shops, resort is made to special runner cup designs incorporating baffles and like devices for keeping dross out of the sprue. There is no technical objection to these practices. The author's feeling is that the expense of this special attention to the first parts of the system can be spared, if the design of the later parts of the system is proper. Simple round sprues can be used, loose or fixed to the pattern as convenient. Runner box design need not be elaborate; it need be dictated only by considerations of being able to fill the cup promptly without splashing metal over the top and down the risers. It is found that, frequently, runner boxes may be dispensed with entirely, and the metal may be poured directly into an enlargement of the sprue in the top of the cope.

Using the gating principles above described, it has been found possible to pour all jobs through a single sprue, unless they reach such a size that the capacity of a single pouring crucible is insufficient to fill the mold. It has never been found necessary to resort to a second sprue for the purpose of overcoming a problem of drossing the runner system.

The system described above leaves complete latitude as to choice of pouring temperatures. Higher temperatures tend to increase dross formation, requiring more rigid adherence to the principles discussed. If the metal is poured quite cold, one can often deviate considerably from ideal gating conditions and yet get a clean casting. But where high temperatures have been required in order to promote running of thin sections or to affect thermal conditions in solidification, it has never been necessary to sacrifice the desired pouring temperature as a concession to the drossing problem.

Screen Area Design. If the screen reservoir is made the lowest cavity in the mold and is filled very early in the pour, it is simply a device for delivering filtered metal quietly to the horizontal runner system. As such, it matters little from a technical standpoint whether the screen is horizontal or vertical, whether it lies in a flat plane or has some other shape. It must, however, have ample total area so that it will not plug up and choke down the rate of flow at any time during the pour. Often, only a limited space is available in the mold that can be allotted to the screen reservoir, without increasing the flask size. In order to get a maximum of screen area in a maximum of space, a cylindrical shape has been found advantageous. The screen reservoir is shaped as a vertical cylinder centered under the sprue, and the screen itself is a concentric vertical cylinder.

Where a large volume of metal is poured through a single screen, the problem of screen plugging is apt to be troublesome. A number of devices are helpful in solving this problem when it arises. Placement of a quantity of coarse steel wool inside the screen provides a pre-filtering action that decreases the rate of plugging-up of the screen. Use of a skim-gate material having a maximum percentage of voids is also helpful. Of course, increasing the depth or diameter of the screen to increase its total area, where space permits, is of value. Lower pouring temperatures decrease drossing and thereby decrease the rate at which the screen will plug up. A serious case of plugging-up of screens may justify resorting to slot sprues and special measures to reduce pouring cup turbulence. In an extreme case, it might become necessary to resort to pouring the mold two-up, though more economical methods are normally effective.

When plugging of screens becomes a serious problem, the metal melting practice should be scrutinized. Good gating practice can correct poor refining of the

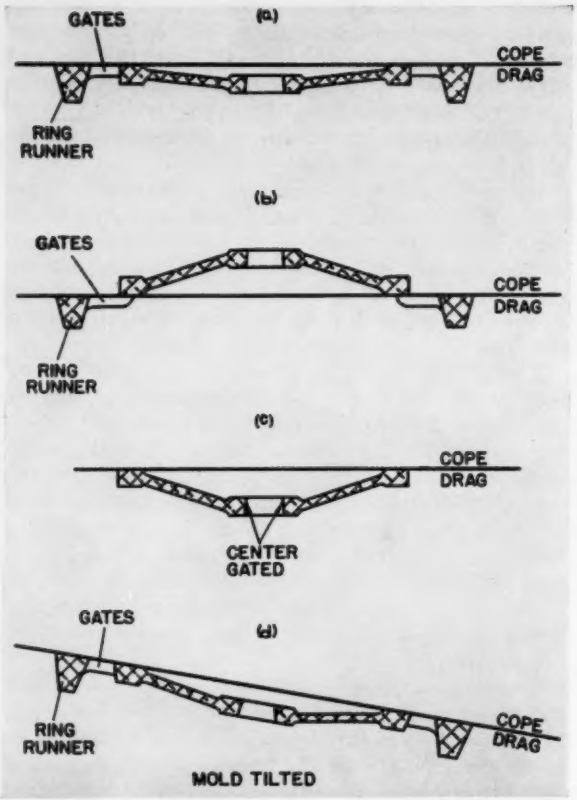


Fig. 3—Flow lines may develop in central part of casting gated as in a. *To avoid, use* b, c, *or* d.

metal to a limited extent, but cannot be relied on as a substitute for good melting practice.

The foregoing discussion of screen design and screening practice has presumed a limited available screen area to handle a large flow of metal, resulting in a tendency for the first metal poured to be sprayed out through the holes of the screen under a pressure head. Sometimes, there is an opportunity to avoid this condition by providing an especially large screen area in relation to the rate of flow required to pass through the screen. If such a large screen area is available to handle a relatively small rate of flow, a quiet seepage of metal through the perforations in the screen can be realized, with no generation of dross on the casting side of the screen. Under these circumstances, the screened metal can be allowed to flow directly into the casting, with no provision for flotation and skimming-off of dross between the screen and the ingates.

Figure 2 shows a frequently employed practice that makes use of this principle. One or more tubular screens are placed in a well or wells having the same height as the mold or mold section. Metal is introduced inside the tubular screen, either at the bottom or at the top. If the diameter of the screen is sufficiently large in relation to the rate of delivery of metal to it, non-turbulent seepage of the metal through the holes of the screen, without spraying, can be expected. Excessive rates of delivery of metal will result in spraying, with formation of dross on the casting side of the screen. In general, greater rates of flow can be successfully handled when the metal is introduced at the bottom rather than at the top. This type of gate can be used to advantage to secure progressive filling of the casting from bottom to top, yet filling top-risers directly from the gating system. Its theory will be discussed later.

Flow Conditions Within the Casting Cavity. The foregoing discussion has dealt with casting inclusions having their point of origin in the runner system of the casting. Another place that non-metallic inclusions can form during the filling of the mold is within the casting cavity itself. It is necessary, but not sufficient, to insure that clean metal enters the ingates of the casting. The casting cavity itself must fill in such a way as to preserve the cleanliness of the metal.

Inclusion-Forming Conditions

Two gating conditions can result in formation of inclusions within the casting cavity. The first is spurting of metal through an ingate, which has already been discussed. Excessive linear velocity of metal at an ingate can produce turbulence at this point, leading to the formation and certain entrapment of films of reaction-product. The prevention of this condition lies in the proportioning of the various members of the gating system so that there is ample total ingate area to handle the full volume of metal delivered to the ingates without generating excessive velocities.

The second common gating condition that can give rise to the formation of inclusions within the casting cavity is a drop of metal from one level to a lower level within this cavity. There is frequently a great temptation to introduce the metal into the casting at some level above the lowest point in the mold cavity. Major molding economies may be realized, as for example by molding part of a deep casting in the drag but introducing the metal at the parting line. Then, too, better conditions of directional solidification may often be attained by introducing the metal at some level other than the lowest, but any large casting that has been so gated should be scrutinized extremely closely for the presence of inclusions. A drop of metal from one level to a lower level within the mold cavity can result in the formation of inclusions by at least three distinct mechanisms.

1. Cascading: If the drop of metal within the casting is extreme and violent, so that the metal literally cascades from one level to a lower level, very obvious defects occur. An example of this occurs when a quantity of metal is accidentally spilled down a top riser early in the pour. Distinct lines of separation between the portions of metal that tumbled down from above and the metal that flowed from below are visible on the surface of the casting. Fractures indicate that these surface lines reflect seams having considerable depth, often completely penetrating the casting wall.

Another way that this defect can occur is by premature flow of metal through the upper gates of a casting that has gates at more than one level. If flow takes place through the upper gates before the metal has attained this level within the casting cavity, a defect having an appearance similar to metal-down-the-riser results.

2. Air Entrapment: When even a small cavity is filled from above, there may not be a complete displacement of the mold gases in the cavity by the inflowing metal. Bubbles of gas may consequently be entrapped.

3. Flow Lines: A third mechanism by which a drop of metal from one level to a lower level in a casting can lead to inclusions is by the formation of flow lines. An explanation of this defect can be made with reference to Fig. 3. When this part is gated into the outer flange as in 3a, the center part of the casting will fill by flow down the inner web wall. Generally, there will not be a uniform flow around the entire circumference of the web; instead, a number of individual streams of metal will run down into the center flange cavity.

An envelope of protective film forms around each of these separate streams. The toughness of this film will depend on the metal temperature and on the length of time of exposure of the surface of the stream to the mold atmosphere.

Often, such a film will become tough enough to be retained in the casting as a definite seam separating the metal that flowed within the envelope from the metal that eventually surrounded it. These seams appear on the surface of the web wall as flow lines. Sometimes they are quite shallow and will readily be removed by a light buffing. Under other conditions, they may penetrate to a considerable depth and be potentially injurious to the serviceability of the casting. Figures 3b, 3c and 3d show acceptable ways of gating to avoid the defect.

Misruns and Cold Shuts. The foregoing sections have dealt with the important problem of avoiding injurious casting inclusions. An equally necessary function of a sound gating system is to achieve a complete filling of the casting cavity. A misrun or cold shut is more obvious than an inclusion, and hence less likely to be overlooked in the inspection of the part. But the avoidance of defects of this class is among the more important gating problems facing the producer of magnesium castings.

The two most obvious ways of correcting a misrun are to pour hotter and to pour faster. Both of these measures tend to increase the drossing tendency of the metal. For this and other reasons, there are other measures that are often preferable to raising pouring temperatures and pouring rates to combat misrunning.

Non-Uniform Pouring Rate. Lack of uniformity of the pouring rate throughout the duration of the pour is a condition frequently associated with misruns. If the gating is such that the rate of pour starts out fast, then slows down markedly toward the end of the pour, misrunning of cope portions of the casting is common. Enlarging the sprue is usually not the solution to this problem. Usually, a plugging of the screening system is found to be at the root of this trouble. Methods of correcting this problem have been discussed previously.

Another cause of reduced pouring rates toward the end of a pour may lie in the human element. It is natural for the pour-off man to anticipate the end of the pour and purposely slow it down, to avoid

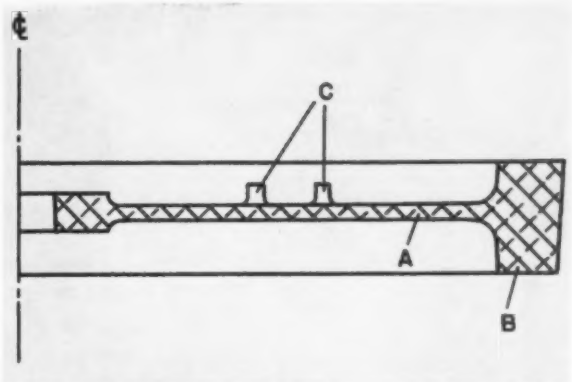


Fig. 4—Bosses at C *may misrun from heavy demand for metal at* B *causing unusually slow rise of metal in* A.

pouring an excess of metal into the casting, only to have it run out of the top risers and create problems for the shake-out man. The pour-off man must be educated to the importance of sustaining a fast rate of pour throughout the pour-off operation, and should be assisted in this aim by provisions to catch harmlessly any accidental overflow of metal.

Design Conditions that Produce Misruns. A casting design condition that is a particularly troublesome source of misruns and cold shuts is the presence of a large expanse of thin wall lying in a horizontal plane at some level of the casting. It is especially difficult to achieve a rapid filling of a horizontal thin wall if there is another large cavity at the same level in the mold competing for the supply of metal that is being delivered. Figure 4 illustrates the problem. The horizontal web *A* must fill at the same time that the heavy flange *B* is filling. Even with a rapid pouring rate, there is a slow vertical rise of the metal in the mold while the massive flange *B* is taking metal. This results in a sluggish flow of metal into the thin web *A*. A boss or bosses *C* attached to the thin web tend to be particularly prone to misrunning, when a design situation of this sort prevails.

Correction of this casting problem is sometimes difficult. Frequently, the best solution to the problem is to tilt the mold, so that the extended thin wall no longer lies in the same horizontal plane as the massive flange. This results in a more rapid filling of web *A*, and a progressive filling from the lower to the higher side; thus there are no sluggish streams of rapidly cooling metal that are expected to join and knit together when they meet in the center of the web.

Another point to remember when this difficult design situation prevails is to avoid aggravating the problem by injudicious location of risers. From a feeding point of view, there is much to be said for a side riser of the type sketched in Fig. 5a. However, the addition of mold cavities that must fill during the same interval that the horizontal web is filling aggravates the misrunning problem, and for this reason, top risers as shown in Fig. 5b may be preferable. It is possible to achieve the advantages of both types of riser with the design in Fig. 5c.

Kinetic Energy of Metal Combats Misruns. A device not to be overlooked in combatting misrunning is utilization of the kinetic energy of the stream of in-

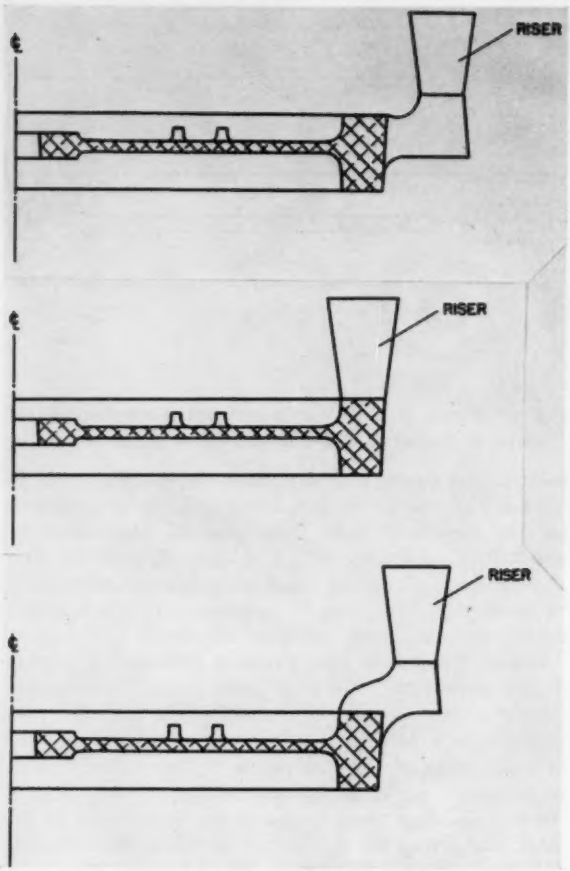


Fig. 5—Side riser (upper) aggravates condition of slow metal rise in web. Top riser gives better metal rise but poorer feeding (center). Advantages combine in lower application shown in lower drawing.

flowing metal to assist in the complete filling of a hard-to-fill cavity. The stream of metal flowing into a mold acquires considerable kinetic energy. This is normally dissipated gradually as the large open risers that are common in magnesium casting practice are allowed to fill. If provision can be made so that the motion of the metal is brought to a halt abruptly, the sudden absorption of this kinetic energy causes the development of considerable pressure of the metal against the surrounding mold walls. This results in a very sharp filling out of the mold cavity.

In practice, an abrupt halting of the flow of metal into a mold or portion of a mold is achieved by limiting vents or open risers into which the metal may flow at the moment of complete filling of the casting cavity. If there is no place else for the metal to go at the moment of complete filling of the mold, there must necessarily be an abrupt stopping of the metal stream.

If this principle is overdone, excessive pressure of the liquid metal against the mold wall may develop. This can cause penetration of the metal into the pores between sand grains, resulting in a very rough surface. Figure 6 illustrates the application of these principles to a small thin-walled casting. If the vent *A* is too ample, flow into the thin-walled casting may be slug-

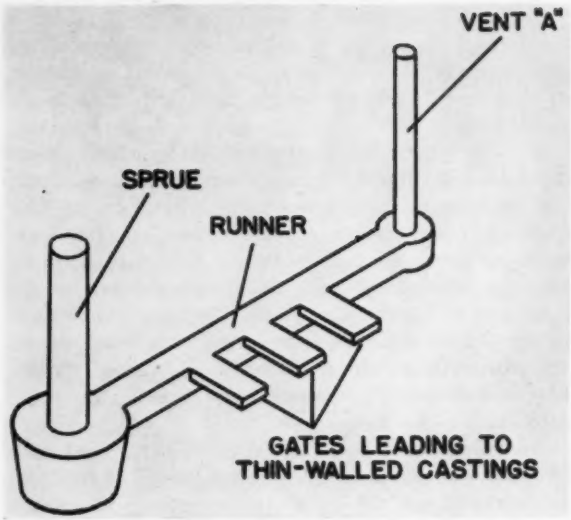


Fig 6—When properly proportioned, vent A *allows gases to escape but does not provide so much relief of metal flow that casting will misrun.*

gish, resulting in misruns. Eliminating vent *A* altogether results in high velocity of entry of metal into the casting cavity and the development of considerable pressure promoting complete filling of the casting cavity.

Complete elimination of vent *A* is unwise (safety reasons discussed below) because it will usually produce excessive entry velocity and metal pressure, resulting in entrapment of mold gases or excessive roughness of the casting surface. Ideal results may be obtained by selecting just the right size vent *A*. There are sometimes opportunities to apply this same principle to portions of large castings.

Safety Precautions. One important safety precaution regarding the gating of magnesium alloy castings should be noted. A rapid flow of magnesium alloy into a blind cavity is a condition that must be avoided. This condition is particularly hazardous when the molding material is high in moisture content, or when it is rammed hard, or when for other reasons it is low in permeability. A serious explosion of the mold can occur, accompanied by sudden expulsion of the metal from the mold.

The precautions to be taken to avoid this hazard are simple. Ample venting of the runner system of any reasonably large sized casting should be provided, especially when large flow rates through the sprue are employed. The normal risers are usually ample as vents for the casting cavity itself. Careful provision should be made to avoid the entrapment of a pocket of mold gases in some blind portion of the runner system; this provision normally takes the form of simple pop-ups or vents over any portion of the runner where a pocket of gases might otherwise be entrapped in the initial rapid filling of the runner system.

Part 2 of this paper—covering risering of magnesium alloy castings—will appear in the next issue of *American Foundryman*.

Recommended Names For Gates And Risers

Prepared by the Gating and Risering Committee, Gray Iron Division, American Foundrymen's Society

This chart is for molders, patternmakers, apprentices, and others in the foundry industry. It recommends STANDARD NAMES for gates and risers in CAPITAL LETTERS and shows other commonly used names in (parentheses). Its purpose is to make it easier for foundry newcomers to learn and for the oldtimers to get together. The section below tells about gates and risers very generally. The definitions are more detailed.

The elements of a basic and very common GATING SYSTEM are the DOWNSPRUE, through which metal enters the RUNNER, and from which it in turn passes through the INGATES into the MOLD CAVITY, as shown in Fig. 1. That part of the gating system which most restricts or regulates the rate of pouring is the PRIMARY CHOKE, more often call simply the CHOKE. At the top of the downsprue may be a POURING CUP or POURING BASIN to minimize splash and turbulence and promote the entry of clean metal only into the downsprue. To further prevent the entry of dirt or slag into the downsprue, the pouring basin may contain a SKIM CORE, a STRAINER, a DELAY SCREEN, or a SPRUE PLUG. To prevent erosion of the gating system when a large amount of metal is to be poured, a SPLASH CORE may be placed in the bottom of the pouring basin, at the bottom of the downsprue, or wherever the flowing metal impinges with more than normal force.

Castings of heavy section or of high shrinkage alloys commonly require a RISER or reservoir where metal stays liquid while the casting is freezing. The riser thus provides the FEED METAL which flows from the riser to the casting to make up for the SHRINK which takes place in the casting metal as it changes from liquid to solid. Depending on the location, the riser is described as a TOP RISER or SIDE RISER and may be either an OPEN RISER or a BLIND RISER. Since risers are designed to stay liquid while the casting solidifies, RISER HEIGHT and RISER NECK are important dimensions as are those of the body of the riser itself. RISER DISTANCE and the shape of the RISER BASE are additional important details that pertain only to side risers.

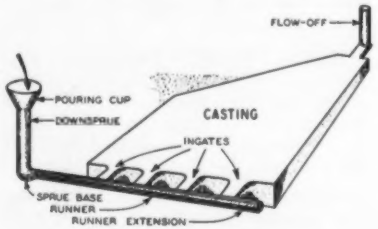


Fig. 1—Finger-gated casting with flow-off.

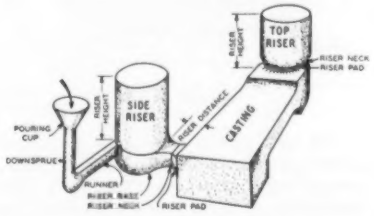


Fig. 2—Riser-gating with side and top risers.

Gates and risers are often designed to take advantage of the principle of CONTROLLED DIRECTIONAL SOLIDIFICATION which requires that freezing starts farthest from the riser and proceeds toward the riser. To accomplish this, castings are RISER-GATED with metal entering the riser through a downsprue and runner, heating both the riser base and riser neck while flowing into the mold cavity, as shown in Fig. 2. A good general measure of whether gates and risers are the proper size may be had by calculating CASTING YIELD.

Definitions

GATING SYSTEM (gates)—In every day terms, the arrangement of "plumbing" which conducts metal into the mold cavity.

DOWNSPRUE (sprue, downgate)—The first channel, usually vertical, which the metal enters; so called because it conducts metal down into the mold.

SPRUE BASE (button)—An enlargement or rounded section at the bottom of the downsprue, used to help streamline the flow of metal into the runner.

RUNNER (crossgate)—The second channel, usually horizontal, through which the metal flows toward, or is distributed around the mold cavity.

INGATE (gate)—The third channel through which the metal leaves the runner to enter either the mold cavity or riser adjacent to the cavity.

RUNNER EXTENSION—That part of a runner which extends beyond the farthest ingate as a blind end. It acts as a dirt trap since the first rush of metal along the runner will pick up any loose particles of sand or dirt and carry them into the extension and not into the mold cavity.

MOLD CAVITY—The hole which, when filled with metal becomes the casting. Gates and risers are not considered part of the mold cavity.

PRIMARY CHOKE or CHOKE—That part of the gating system which most restricts or regulates the flow of metal into the mold cavity.

POURING CUP—The flared section of the top of the downsprue. It may be shaped by hand in the cope, or may be a shaped part of the stick used to form the downsprue, or may be a baked core cup placed on top of the cope over the downsprue.

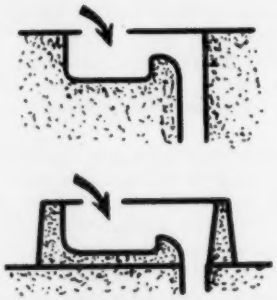
Pouring Cup

POURING BASIN—A basin or trough into which the metal is poured and from which it enters the downsprue. It may be cut into the cope or may be a baked core basin set on top of the mold, or it may be a trough rammed up in a wood or metal frame as when it is desired that the metal enter two or more downsprues at the same time.

Illustrated on next page

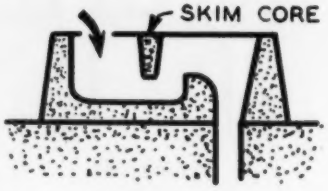
Recommended Names For Gates and Risers

(continued)



Pouring Basin

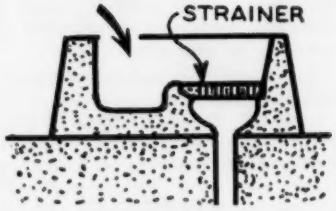
SKIM CORE (skimmer)—A flat core or tile placed to skim a flowing stream of metal. Commonly used in pouring basins,



Skim Core

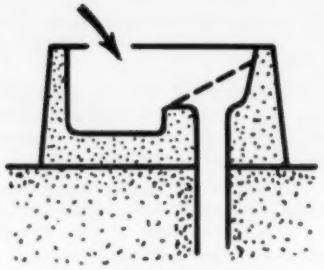
it holds back slag and dirt while clean metal passes underneath to the downsprue. Skim cores are also used elsewhere in gating systems.

STRAINER—A core (strainer core) or tile (strainer tile) or ceramic coated screen with many small holes. Used in a pouring basin, the strainer restricts



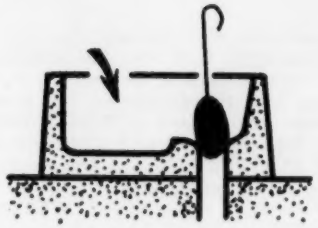
Strainer

flow of metal so that the basin fills quickly and only clean metal enters the downsprue. Strainers are also used at the bottom of the downsprue and elsewhere in the gating system where desired to restrict the flow of metal.



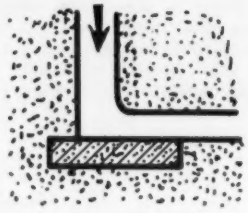
Delay Screen

DELAY SCREEN (skim gate, skim strainer)—A small piece of perforated light gage tinned sheet steel frequently placed in the pouring basin at the top of the downsprue. It delays the flow of metal long enough to allow the basin to fill before it melts to permit only clean metal from the bottom of the basin to enter the downsprue. Delay screens are also used elsewhere in the gating system.



Sprue Plug

SPRUE PLUG (stopper)—A stopper placed at the entrance of the downsprue. Usually of cast iron or graphite, it ensures positive flow of clean metal into the downsprue since it is pulled only after the start of pour, when the basin is full of metal.



Splash Core

SPLASH CORE—A core or tile placed to prevent erosion of the mold at places where metal impinges with more than normal force. Splash cores are commonly used at the bottom of large rammed pouring basins, at the bottom of long downsprues, or at the ingates of large molds.

RISER (head, feed head)—A reservoir connected to the casting so as to provide liquid metal to the casting during solidification to offset the shrinkage which takes place when the casting solidifies.

SHRINK (draw, pull)—The difference in volume between liquid metal and solid metal or the hole left in a casting because of that difference. Castings of high-shrinkage alloys require that extra metal flow into the casting while it is solidifying, otherwise there will be a shrinkage cavity in place of the last metal to solidify.

FEED METAL—The volume of liquid metal that passes from the risers to the casting to make up for the shrink.

TOP RISER (top head)—A riser attached to the top surface of a casting.

SIDE RISER (side head)—A riser attached to the side of a casting.

OPEN RISER (open head)—A riser which cuts through the cope surface of a mold.

BLIND RISER (blind head, blind bob, shrink bob)—A hidden riser, not seen by looking at the top surface of the cope. Blind risers generally are more efficient and less expensive than open risers, but can be used only under certain conditions.

RISER HEIGHT—The distance from the top of the riser when liquid to the top of the riser neck. Riser height when solid may be several inches less than when liquid because of loss of feed metal to the casting.

RISER NECK—The connecting passage between the riser and casting. Only the height and width, or diameter, of the riser neck usually are reported, although the shape may be equally important.

Recommended Names For Gates and Risers

(continued)

RISER PAD (riser contact)—An enlargement of the riser neck where it joins the casting. The purpose of the pad is to prevent "breaking in" of the riser when it is struck or cut from the casting.

RISER DISTANCE—The length of the riser neck. The term is applied to side risers only.

RISER BASE (drag bob)—The shape of the bottom of a side riser.

DIRECTIONAL SOLIDIFICATION (controlled freezing)—A basic rule for the intelligent placing of risers. It requires that solidification start at the farthest point from the riser and proceed progressively toward the riser. With directional solidification the riser can provide feed metal for each part of the casting as required and the casting will be sound.

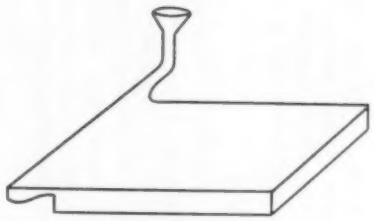
RISER-GATING—Practice of running metal for the casting through the riser to help directional solidification.

CASTING YIELD—Weight of cleaned rough casting divided by total weight poured expressed as percent.

FINGER GATE (branch gate)—A gating system with two or more ingates from the same runner, shown in Fig. 1. It distributes metal to several parts of the mold cavity.

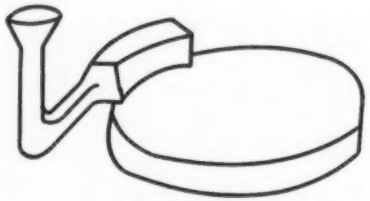
STEP GATE—A gating system with two or more ingates at different elevations from a vertical runner or downsprue.

KNIFE GATE—A slit opening 3/16-1/4 in. thick and any length through which metal enters the mold cavity.



Knife Gate

Knife gates are usually poured on downhill tilt to provide progressive filling of mold cavity. Knife gates are easy to remove.



Lap Gate

LAP GATE—A slit opening 1/16 - 3/16 in. thick, usually less than 3 in. in length, formed by overlapping the runner with an edge of the mold cavity. Lap gates are easy to remove.

HORSESHOE GATE—A gating system where a runner and two ingates are combined in the shape of a horseshoe. This gating system is easy to hand-cut and to remove from the casting.

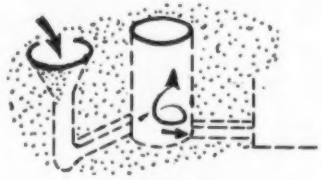
SHOWER GATE (pencil gate, pop gate)—A gating system by which metal showers into the mold cavity from a group of small gates at the top.

Horseshoe Gate

BOTTOM GATE—Any gating system by which metal enters the mold cavity at the bottom.

HORN GATE—A curved bottom gate by which metal flows down under then up into the mold cavity. A REVERSE HORN GATE is attached by the large end to the casting to reduce turbulence in the metal.

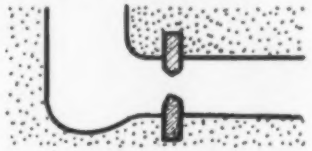
WHIRL GATE—A gating system in which the metal enters a circular reservoir at a tangent, and so whirls around, leaving dirt and slag behind before passing into the mold cavity.



Whirl Gate

SKIM BOB—A small upward bulge in the ingate an inch or two from the casting which acts as a dirt trap.

NECK DOWN (wafer core, knock-off, Washburn, or Cameron core)—A thin core or tile used to restrict the riser neck, making it easier to break or cut off the riser from the casting.

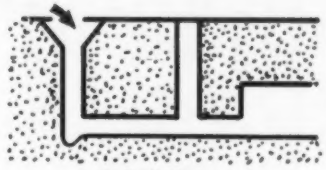


Neck Down

VENT (whistler)—A small channel from the top of the mold cavity for letting air and mold gases escape as the metal fills the mold.

FLOW-OFF (pop-off, strain relief)—A large vent, usually located at the high point of the mold cavity. In addition to letting air and mold gases escape as metal fills the mold cavity, the flow-off fills with metal and acts to relieve the surge of pressure near the end of pouring.

RELIEF SPRUE—A vertical channel, the approximate size of the downsprue, connected to the runner to relieve pressure surge during pouring. It functions like a standpipe in a plumbing system.



Relief Sprue

SET GATES—Gating systems formed by patterns, in contrast to gates cut in the sand by hand.

PENCIL CORE—A core projecting to the center of a blind riser to admit atmospheric pressure to force out feed metal.

★ 1954 Convention Preprint

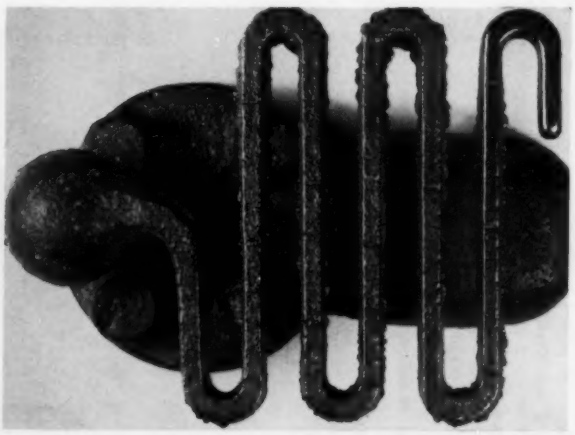
Fluidity vs. Core Blows In Automotive Gray Iron

ALLEN A. EVANS / *Special Assignment, International Harvester Co., Indianapolis, Ind.*

Gas inclusions and porosity trends can be predicted by measuring iron fluidity with a new test. Written discussion of this paper, Convention Preprint No. 54-32, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Gray Iron Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ Some observations of the flow properties of iron and their corresponding effect on quality of the casting, as well as the practicability of various testing devices are discussed in this paper. All the investigations and observations were made in a mechanized foundry. A continuous conveyor molding unit delivers the castings to the cooling conveyor, where a continuous chain delivers them to an automatic blast cleaning unit. This continuous cycle of approximately four hours from the mold to the cleaning operation, helped simplify the correlation of fluidity with physical defects.

The project originally started out as a study of gas inclusions or core blows. Core blows had been a chronic defect in the casting of cylinder blocks and heads, and at the start of the study there were indications that fluidity played a part in core blow epidemics. This condition had various degrees of severity.



In this test sample measurement of fluidity is in one-inch increments. Reading for this sample is 15¼ in.

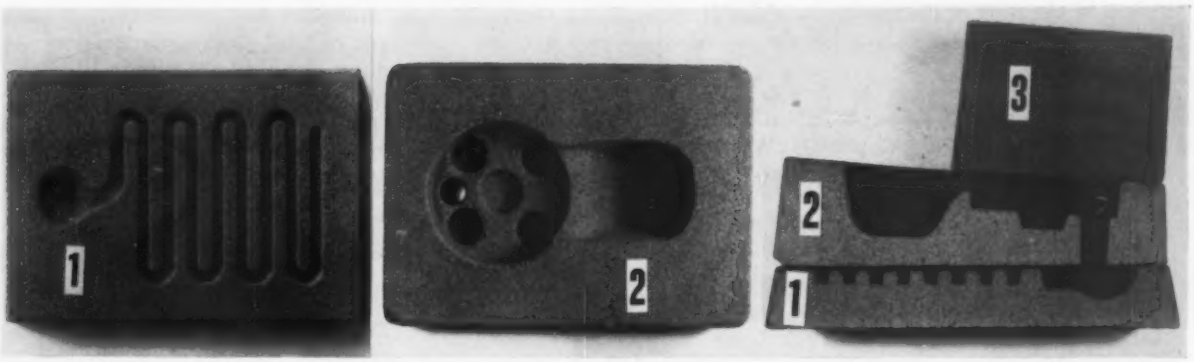
In the past, it had been the practice during a bad blow period to blame the core room. If a carbon core wash was being used, it was changed to a silica core wash or if a silica dip was being used, it was changed to a carbon dip. The first thing to do was cut the amount of core oil and change the sand; and changing the vents was always a must. In fact, so many changes were made that when the blows cleared up, it was impossible to say just what did cure the condition.

Investigation. It was important to determine the pattern of the blow condition. To do this, a sample inspection of the castings after cleaning was set up, using percentage of blows per hour as the measuring unit. When this information was charted on a quality control chart, the trend pattern could be observed, with a variation from zero to 40 per cent. This did not necessarily mean scrap, but it did mean excessive cost in the salvage operation.

In trying to create blows by increasing the amount of core oil, it was found that a slight change could not cause a blow. The amount of core oil being used was about 1.3 per cent. The oil had to be increased to over 2 per cent before a blow was created. This proved that a slight mistake on the part of the muller operator could not be blamed for core blow epidemics, and that the usual practice of deleting 0.1 per cent core oil could not help the condition.

After observing the blow pattern for some time and trying to tie in some cause factors, a definite pattern of events began to develop. One day, during the third hour, the molding unit foreman discovered an unusual phenomenon. The sprues and pouring basins of the castings at the cope shake-out were still mushy 20 minutes after pouring. The castings had solidified because they were thinner. When castings were inspected four hours later, after they had been cleaned, it was found that there was not a single blow in the third hour's production.

Another condition was brought to the attention of the investigators. On one particular cylinder block mold, a flowoff vent was being used. This came through the side of the cope flask at a point two inches lower than the top of the pouring basin. It was ob-



(Left) Fluidity testing gauge, consisting of receiving basin and serpentine-shaped flow passage. (Center) Gating mechanism and pouring basin. (Right) Sectional composite of fluidity testing device. Cover core is 3.

served that the amount of iron flowing out of the ¼-in. diameter flowoff varied at different times of the day, from just a few drops to a continuous stream. During these periods, there was very little difference in temperature. By comparing the different periods of flow with the corresponding percentage of blows per hour, it was found that when the flowoff froze quickly the percentage of blows was high. When the flowoff froze slowly, the percentage was lower.

At this point, it was concluded that there definitely was a relationship between the rate of solidification and core blows. A plausible explanation for this is that gas permeating the molten metal was being trapped by the slower solidifying metal. As the metal fills the mold cavity, there is a tendency for the gas pressures to try to equalize, that is, the core gases will permeate the hot metal in an attempt to equalize the mold gas pressures.

How the Problem was Solved. The next step was to measure the flow characteristic and set up controls. While there are a number of different testing devices, most are too cumbersome and do not control the velocity of the metal poured satisfactorily. A new testing device was developed.

The new fluidity test (see illustration) is poured in a three-part dry sand mold. Part 1 is the fluidity testing gauge itself, consisting of a receiving basin and the serpentine flow passage. Reference marks are provided along the flow passage at 1-in. intervals to determine the length of flow.

Part 2 is the gating system and pouring basin. The pouring basin is connected to the head-pressure chamber by a constant size gate. The head-pressure chamber is the circular cavity with four short legs and a constant size pencil gate (this acts as a restricting orifice) leading to the receiving basin of Part 1. The head-pressure chamber has a double purpose: (1) It controls the velocity of the molten metal. (2) It is designed so that it can be used as a spectrograph pad for spectro analysis. This is of great value in correlating chemical analysis with flow properties.

Part 3 is merely a cover core of sufficient size to cover the head-pressure chamber and the gate to the chamber. It should also be of sufficient weight to hold the mold together.

In developing this testing device, it was not attempted to duplicate actual mold and casting conditions. Some foundrymen feel that a testing device of this type should be made out of the same green sand being used for molds. They try to duplicate molding conditions and gating practice. What is needed is a gauge, a measuring device that will measure the flow characteristic of metal. Another instrument is needed to give us an indication of the quality of the metal in the molten state. Metal temperature and chill tests have been used for some time, and now the flow characteristic can be added as one more tool for better control.

After the test device was designed and perfected, a test procedure was set up. A test was poured every 15 minutes and an average hourly flow was computed for each hour. The average flow was posted on a quality control chart. Scatter diagrams and charts were constructed to prove the correlation between percentage of blows per hour and fluidity.

Previous to the use of this test, there were only two kinds of iron—hot iron and cold iron. It was soon determined that not all hot iron was good iron. It was found that some 2850 F iron had less fluidity than 2600 F iron. Temperature alone is not the controlling factor in fluidity, chemistry also having a significant effect.

Various Fluidity Testing Devices. The merits of various fluidity testing devices have been the subject of much discussion. Several requirements that should be met by any fluidity testing device are: (1) Velocity of the metal poured must be controlled. (2) The device should be small in size and simple to assemble. (3) Results should be constant within practical limits. The Currie device of 1946 has been used with various degrees of success both here and abroad. The height from which the metal is poured controls the accuracy of this test. The height of pouring determines the velocity. A 6-in. drop of molten metal develops a velocity of about five feet per second, while a 10-in. drop will develop about seven feet per second velocity. While the orifice tends to restrict the flow, it does not control the velocity.

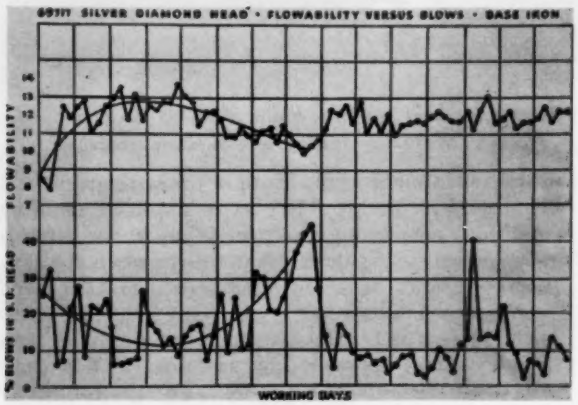
In Currie's attempt to obtain an immediate result without waiting for the metal to solidify, visible flowoffs were incorporated along the spiral passage. It would seem that these flowoffs would have an uneven retarding effect upon the metal. Each small flowoff would freeze progressively, and have a graduated restricting effect. The flow should not be restricted. The metal should have the same opportunity

to flow at the start of the passage as it has at the end. The only restricting force should be the rate of solidification.

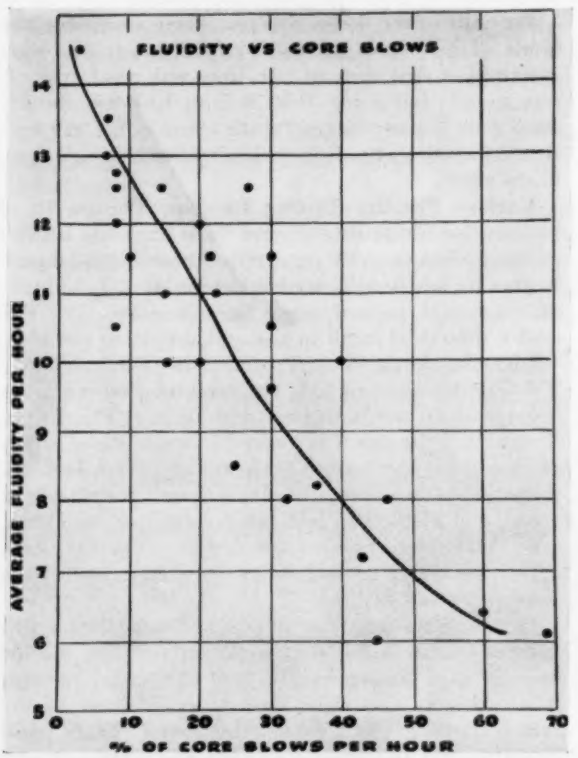
The Reece device, one of the more practical tests, is a recent (1952) development. A carbon stopper rod is used to insure the control of velocity. When the pouring basin is full, the ladle lip is used to lift the stopper rod. The measured amount of iron then flows into the spiral passage at a controlled velocity. In some similar devices, difficulty has been experienced in keeping the stopper rod from floating or leaking.

The Evans testing device, developed in 1951, was designed to be used as a process control tool. It is possible to have a slight variation in readings on the same metal. However, it is felt that this device is as reliable as any yet developed.

An attempt is not made to reject iron when the fluidity gets low because there is no place to put it. The iron must be used unlike some shops which have certain jobs in which low fluidity iron can be used. The main use of the test is to follow the trends. There is a continuous fluctuation; however, the trend is relatively slow. The extent of the trend can be predicted, and chemistry changes made to correct the conditions.



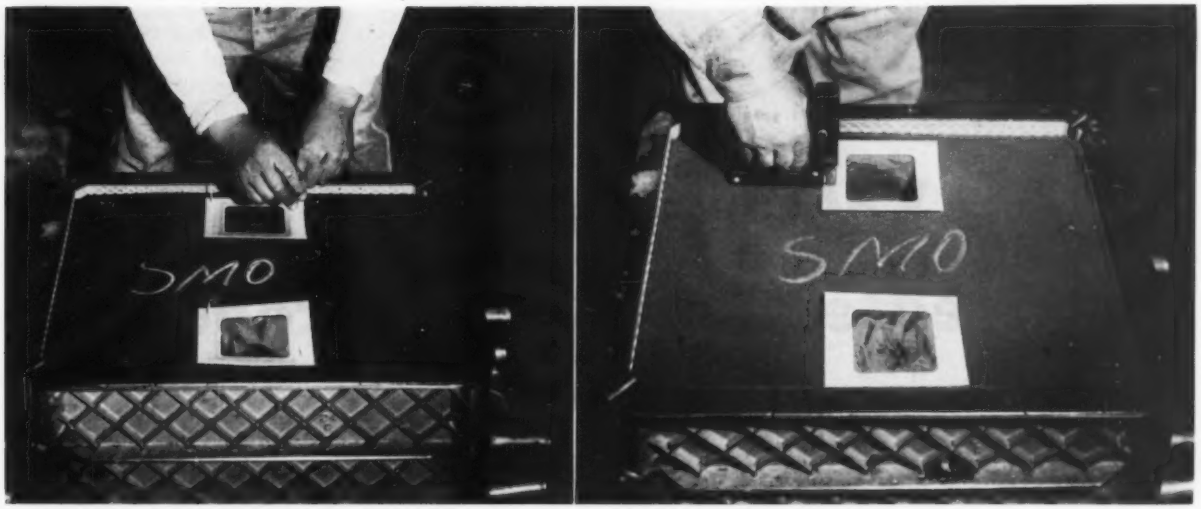
Comparative charts, showing trend relationship between core blows and flowability of iron. Each point in upper chart represents average daily flowability. Each point in lower chart is daily percentage of blows. Blow condition charted represents all gas cavities that are visually detected, from pin holes to large cavities.



Scatter diagram, showing the relationship between fluidity occurrence and core blows.

Pouring fluidity test. A test is poured each 15 minutes. An average fluidity is computed every hour and plotted on quality control chart. Cover core used here is also a chill test specimen.

One of the most important benefits that can be obtained from fluidity process control, is that it is invaluable as a trouble shooting device. For best results, a quality control chart should be used to record the data. Either natural process limits or modified limits can be used as specifications. The specifications should be established only after a thorough study has been made. This study should correlate physical defects with the fluidity characteristic of the iron. Each foundry operation has its own peculiar problems which prevent the establishment of a universal standard testing procedure. Nevertheless, each group that investigates fluidity to set up controls will add more knowledge to the growing pool of information. This, in turn, will lead to improved foundry practice.



(Left) Attaching cellophane covers with toothpicks. (Right) Stapling covers into place on sand mold.

Cellophane Covers Used to Keep Dirt Out of Molds

Ingenuity pays off in the foundry as in any industry. Read how one New Jersey plant solved the aggravating problem of dirt and other atmospheric contaminants mixing with its stainless steel castings in the mold. A unique solution was found, at little cost.

■ In order to keep dirt and other impurities from entering sand molds and contaminating castings before solidification, technicians at Cooper Alloy Foundry Co., Hillside, N. J., are using a simple but effective protective device.

Squares of cellophane are glued to light cardboard frames and then placed over the open riser heads as soon as the molds have been closed. In most instances, the frames are attached to the molds by wooden toothpicks. With larger molds that are too hard for the toothpicks, the cellophane covers are stapled into place.

The covers are fastened on two corners only, thus allowing for continual ventilation and avoiding condensation of moisture. Just before the metal is poured, the covers are brushed clean and the molten metal (stainless steel at Cooper Alloy) is poured right through the transparent cellophane.

Method illustrates how the alert foundryman can improvise with readily available, inexpensive materials in eliminating troublesome problems.

Steel is poured through cellophane for clean castings.

★ 1954 Convention Preprint

Gating Yellow Brass Castings For Greater Production Economy

C. L. Mack / *Foreman, Chautauqua Hardware Corp., Jamestown, N. Y.*

A flexible, effective approach to re-gating several hundred thin patterns was worked out by combining the author's experience and the recorded experiences of other foundrymen. Written discussion of this paper, Convention Preprint No. 54-3, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Brass & Bronze Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ The purpose of this paper is to demonstrate the value of principles of gating developed by others[1, 2, 3] through application of these principles in actual production runs, and to show departure from recommended practice is often permissible. The work deals with the cheapest of copper-base alloys (average composition 65.80% Cu, 0.82% Sn, 2.00% Pb, balance Zn) which seems to be losing popularity in the foundry today. If the industry can reduce the final cost of yellow brass castings, a great variety of work will be returned to the sand foundry. If this paper demonstrates that there are better ways to produce good castings from low cost ingot, it is reasonable to assume that smelters as well as foundrymen may support a program of research in this sadly neglected field.

The work described here is a project of Chautauqua Hardware Corp., Jamestown, N. Y. This firm purchased several hundred gated patterns and has re-gated many of them so castings can be produced more efficiently.

Supplements for Wider Range

The foundry uses natural sand with a grain fineness of 150 to 175. This base sand is supplemented with additions of other grades to give the foundry a wider range of sand properties. Samples of the sand used in the production of thin castings were sent to a laboratory for testing. The report indicated that the sand had an AFS permeability of 13 and green compression strength of 6.3 psi when the moisture content was 7 per cent.

Most of the patterns consist of several pieces gated to one, two, or three runner bars, according to the size of the patterns, and are poured through a single sprue. These patterns are used with a hard plaster match or follow board as shown in Fig. 1 and 2. A

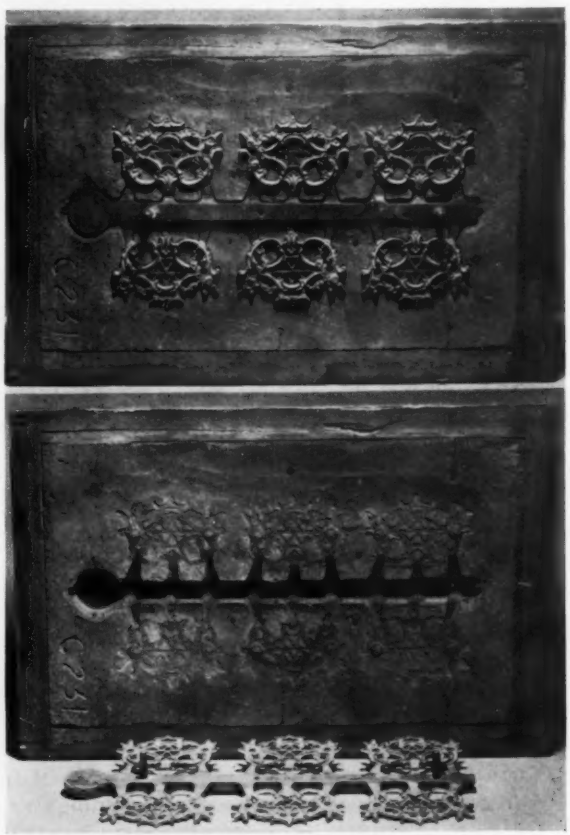


Fig. 1—Old style gatted pattern and sand-litharge match. Runner and gates are in cope, gates are attached to sides of runners. Angle of outside gates on each piece directs metal flow toward center of casting. Misruns and pitted surface caused high rejection rate.

12 x 16-in. flask with a 2¼-in. cope and drag may contain from two to 40 pieces. The largest casting in regular production has a conical core 9 in. long and weighs 1¾ lb while the smallest has nearly 200 pieces to one pound of metal.

A charge of 200 lb of yellow brass is brought to a slight flare in oil-fired crucible furnaces, deoxidized with 0.2 per cent aluminum,[4] and poured at a temperature dictated by the size and design of the castings.

Need Quality for Aged Appearance

The finished product is furniture hardware—period and modern. The realistic reproductions of the older periods require an extremely smooth, aged appearance that is difficult to achieve unless the castings are of top quality. Final cost and appearance are the prime considerations since mechanical properties are seldom questioned. Most of these castings are finished by barrel tumbling. If excessive tumbling is necessary to impart the desired smooth surface, the intricate designs and etchings are lost. Some assembled jobs require good ductility. Castings that have been tumbled too long become brittle and are frequently broken in the assembly department.

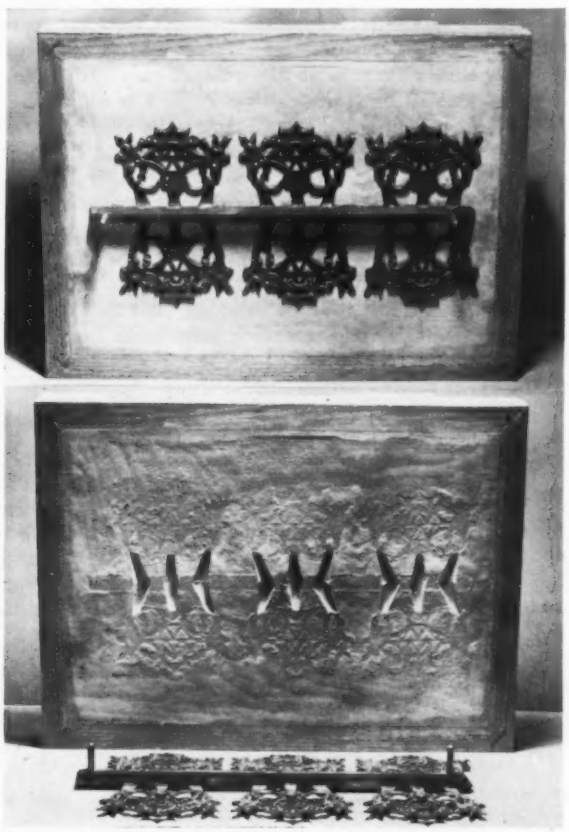


Fig. 2—New style gating and plaster match with runner in drag, gates in cope. Gates direct metal to outer edges of pattern along natural flow line. Guide pins on drag side of runner insure accurate pattern draw.

Former practice was to use large gating systems and to pour hard and fast at high temperatures to avoid misruns in the thin castings. This procedure was costly and created a serious smoke condition. It also caused fins which were difficult to remove from the intricate designs common in this line of work. These patterns had the runners and gates in the cope (Fig. 1 and 5) to assure pressure and good feeding for the castings.[5,6] Misruns tended to occur near the sprue and the castings at the opposite end of the runner were often rough as with sand penetration. Routine checkup revealed that the molds did not have soft areas that might have caused the penetration defects.

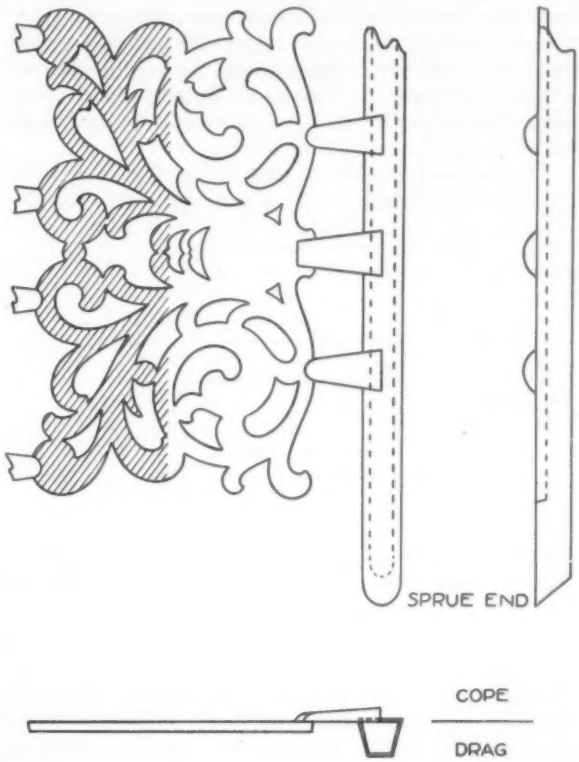


Fig. 3—Gates are ⅛ x ¼-in. in cross section at point of contact with casting. As gate approaches runner, size increases to ¼ x ⅜ in. Slightly larger center gate permits entry of more metal.

Questionable Results When Inverted

Some of the original patterns were inverted to place the runner and gates in the drag. The mold cavity was then in the cope. Rather good results were obtained in a few cases but there was a general increase in dross and shrinkage defects. An attempt to follow the principles of ratio gating described in AFS research reports was considered unsatisfactory because of higher production cost and lack of proper equipment. Although this system of ratio gating was not adopted, it is recommended for the production of high quality castings.

A study of technical literature pertaining to metal

behavior in the mold suggested that a direct approach to the problem would be required. Experiments indicated that the principles developed for other alloys could be modified to fit the needs of specific castings and to permit the use of available equipment.

Development of Gating Technique. Although the same methods (with provisions for proper feeding) were successfully applied to larger castings, this report deals only with very thin castings having a high rejection rate due to misruns or faulty gating and pouring techniques. The factors below received attention in designing the new gating system.

The size and number of gates on each casting were based on the size and design of the casting. When misruns occur it is common practice in many foundries to remove some of the patterns or to attach additional gates to the ones most frequently affected. With proper gating systems, the number of gates required to run one casting in a mold, is sufficient for any number of patterns. Test molds proved that when the gates were considerably thicker than the casting, pits were found in the vicinity of the gates and grinding costs were very high. A $\frac{1}{8}$-in. gate produced the best results for castings that were $\frac{3}{32}$-in. thick. Often the area available for gating was limited because of perforations. These factors led to the use of gates with a cross-section of $\frac{1}{8}$ x $\frac{1}{4}$ in. The size of the gate was increased as it approached the runner (Fig. 3) to lend structural strength to the final pattern. If the casting was of the solid flat type a wider gate was used.

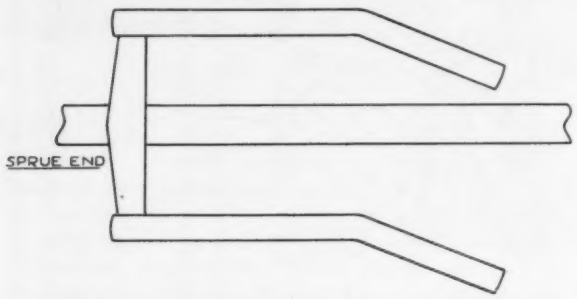


Fig. 4—Experimental castings made to show that rod bent toward runner often would misrun because of excessive development of mold gas.

Erosion from Improper Gating

The principles of fluid mechanics and inertia have been important factors in the development of gating systems, and in the control of flow conditions in the sprue, runners, and gates. These factors and their relation to the flow of metal in the mold cavity influenced the location of the gates on the pattern. If high velocities and turbulence should be avoided in the runners and gates, the same rule must apply to that portion of the mold that forms the casting. The frequency of erosion and misruns could often be traced to improper location of the gates. Castings that have multiple curves or Y-shaped sections are highly susceptible to the adverse effect of inertia, unless the gates are properly placed.

The value of proper location of the gates on a commercial pattern is demonstrated in Fig. 3. The four gates shown in the shaded area produced rougher castings and more misruns than the three gates attached to the other side of the pattern. When two pieces of rod stock of identical size were placed in a mold as shown in Fig. 4, and poured at the lowest possible temperature, the rod that curved toward the runner often produced misruns while the other casting was complete. If the mold was properly vented in the affected area this variable was eliminated.

The results of these simple tests led to the assumption that hot metal, passing through the runner, created mold gases in the adjacent cavity and since this section was the last to receive molten metal, the gas pressure resisted the flow of the metal. Judicious placing of the gates will avoid such conditions so full-run castings may be obtained with moderate pouring temperatures. Economy of cut-off operation was also considered in placing the gates on the pattern.

The cross-sectional dimensions of the runner were determined by the distance the metal traveled and the amount of the heat loss that could be tolerated. If small gates for a small casting require very hot metal, a rather large runner may be necessary. Larger castings, if augmented with feeder heads or risers, may very well use smaller runners and short, heavy gates for greater economy. The most popular sizes for runners was $\frac{3}{8}$ x $\frac{3}{8}$ in. for large castings and $\frac{5}{8}$ x $\frac{5}{8}$ in. for very thin pieces. With the runner enlarged to reduce velocity of flow, the casting finish was improved. A very abrupt enlargement such as the design used in the experiments of Johnson, Bishop, and Pellini[3] proved undesirable.

Good results were obtained with a runner 15 in. long; the sprue end was $\frac{3}{8}$ x $\frac{3}{8}$ in. and the opposite end was $\frac{1}{2}$ x $\frac{1}{2}$ in. This runner had a gradual taper over its entire length. Slight variations in these dimensions or in the amount of taper had little effect on the castings. No attempt to determine optimum size or design for specific castings was undertaken due to the great variety of patterns in stock.

Modification of Inertia Effect

The effect of inertia to the flow of metal may be modified by raising the level of some parts of the gating system. When runners and gates were on the same level, considerable force was required to change the direction of flow, and there was a strain on the mold wherever the metal stream was diverted. With the runner in the drag and the gates rising directly above it, entirely in the cope, there was less danger of mold failure and sand wash. Velocity was reduced and a smooth continuous flow of metal was easily maintained. The radius of the fillets at the junction of runner and gates was reduced with no adverse results in the castings.

The alloy under discussion freezes quickly when the flow of metal is temporarily halted. If high back pressure, caused by low permeability, stops the flow for a split second an oxide film will cover the metal. This film will resist the flow of metal and misruns will occur even though the metal is hot. Fast pouring will develop such undesirable pressures, and while

venting the mold or using a more open sand are the usual remedies, the goal—production of low cost castings with a fine finish—is lost. A slower, continuous flow allowed the mold gases to escape through the mold walls without venting.

A reduction in area from the sprue to the runner (3:1 and 2:1), and another mild choke due to the tapered gates, control the pouring rate and provide a system of sprue, runners, and gates that is easily flooded with metal at the start of the pour. The pouring of these small castings is of such short duration that the pour-off man must have a great deal of skill, unless control is incorporated into the gating system.

Production of consistently good castings requires that each cavity of the mold be filled with metal of the same temperature and under the same degree of pressure. To accomplish this the runner was placed in the drag. The first metal entering the mold suffers greater heat loss than the last. This first metal lays in the bottom of the runner and the gates are fed from the hotter metal at the top of the runner. The color of the gates on a runner cast in the drag as compared with one in the cope shows that the drag runner has a more even temperature over its entire length. The runner in the drag was very effective in delivering uniform pressure on all of the castings. The adverse effect of kinetic energy on the castings near the end of the runner was reduced by placing the runner in the drag.

Present Gating System. All of the above features were incorporated into a gating system having one sprue, one to three runners, several gates, and as many castings as the dimensions of the flask would accommodate. It has never been necessary to reduce the number of patterns in a mold because of misruns. The sprue is round, with diameters ranging from ¾ in. to 1¼ in., and is 2¼ in. long. The size of the sprue is dependent on the size and number of runners since a reduction in area at the sprue base helps in maintaining a full sprue during the pour. The short sprue, due to the limited height of the cope, is not tapered to choke the flow of metal. Since the metal falls such a short distance, the sprue functions more like a pouring box than a normal sprue. The mold is poured with the sprue and elevated 1½ in. higher than the opposite end of the 16-in. flask.

The sprue joins the runner at a slight angle to reduce turbulence at this junction. The angle of the sprue aids pouring and cut-off operations. The runners have a tapezoidal cross-section and the dimensions described above. The runner is entirely in the drag with the gates attached to the top rather than the sides as is common practice when the runner is in the cope. The gates are tapered and usually form a right angle with the runner. The angle created by the junction of the casting and the gate is more critical than that of the gate and runner.

The location of the gate and flow conditions within the mold cavity are of utmost importance because this is where the greatest flow velocity is encountered. The runner is extended beyond the last gate to provide a trap for dirt and dross and to reduce the effects of kinetic energy. Although sharp corners are avoided, the use of large fillets has been discontinued.

This method of gating practically eliminates the need for extremely high pouring temperatures, curved gates, sumps, and fillets. Turbulence and velocity of flow is reduced. There is a definite decrease in misruns and the castings have a better finish. The molding time has been reduced and the casting yield per pound of metal poured is greater. Better placing of gates as well as a reduction in the size and number of gates has led to a lower cleaning cost.

The time saved on pattern equipment often amounts to three hours on a 12-piece pattern. All

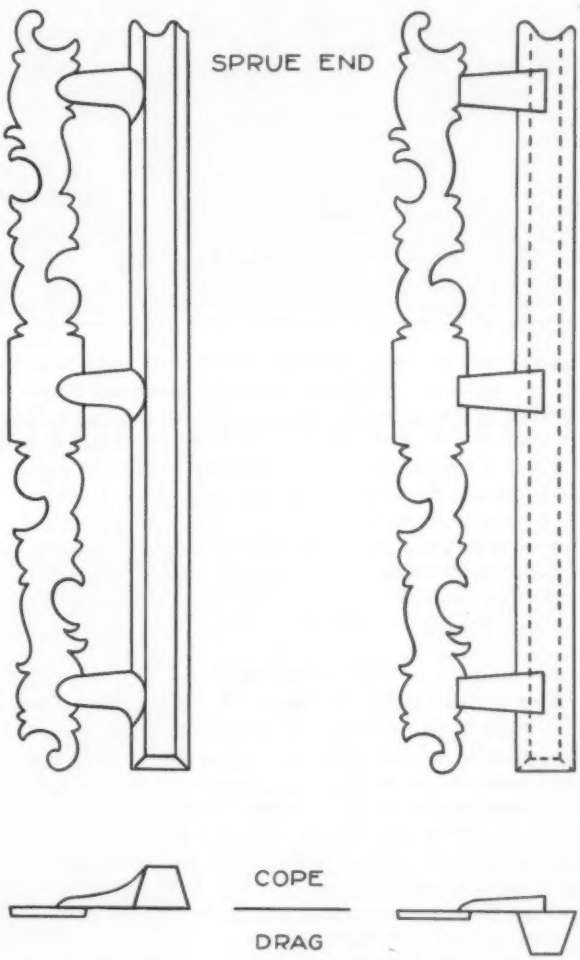


Fig. 5—Old (left) and new gating systems. Castings are 7⅜ in. long, ¾ in. wide, 1/32—1/16 in. thick. Gates are ⅛ x ¼ in. at contact with casting. As gate approaches runner, size increases to ¼ x ⅜ in.

of the patterns used by the foundry—other than pressure-cast plates—are cast in green sand molds, using this method of gating. These pattern castings have excellent surface and require no more cleaning time than patterns that were formerly cast in plaster.

Two patterns similar to the one shown in Fig. 5 were duplicated using the new gating system. These patterns were placed in the production foundry and all operations were carefully supervised. Five molds made from each pattern were poured from the same

heat of metal. With all of the molds made by the same molder and poured from the same ladle, foundry variables were eliminated. This test was made with four separate heats; the two pour-off men alternating.

One worker inspected the resulting castings and rejected 2 per cent from the new patterns and 25 per cent from the old style patterns. The same castings were inspected by another worker who was instructed to pass all that might be salvaged with considerable filing. The results of this inspection was 2 per cent

TABLE I—EFFECT OF GATING STYLE ON CASTING REJECTS

Pattern	Gating Style	Pieces Cast	Good Castings	Total Rejects	Rejects, %
A-190	Old	2220	1820	400	18
A-190	New	2220	2000	220	10
A-189	Old	2220	1920	300	13.5
A-189	New	2220	2020	200	9
C-7	Old	240	215	25	10.4
C-7	New	1040	1010	30	3
C-8	Old	270	210	60	22.2
C-8	New	1050	1040	10	1
C-191	Old	3150	2556	594	18.8
C-191	New	1860	1770	90	5

rejects from the new patterns and 10 per cent from the old patterns. The new patterns produced fewer rejects and the accepted castings were better in every respect.

Table 1 was prepared from foundry records. It does not represent the normal rejection rate of the foundry since these patterns were chosen for re-gating because they were among the most difficult jobs in a group of more than 3000. These castings pass a very rigid inspection because cleaning cost is high, due to the intricate designs and the extremely thin sections.

Acknowledgments

The author wishes to express his appreciation to Earl Palmer, of Chautauqua Hardware Corp. design department, for the illustrations; to the friends and employees of the firm, who cooperated in the tests and experiments; to J. G. Kura, Battelle Memorial Institute, whose interest and advice was most helpful; and to Allan F. Jones, corporation president, whose permission to offer this paper to the American Foundrymen's Society exemplifies the Society's spirit of cooperation and goodwill.

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The first three references can be found in the AFS publication SYMPOSIUM ON PRINCIPLES OF GATING.

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Fourteen Methods for Reducing Grinding Wheel Operating Costs

GRINDING wheel sales in the United States totaled approximately $160 million in 1953, of which about $60 million represented resin bonded wheels, according to K. S. Cowlin, sales manager, grinding wheel division, Electro Refractories & Abrasives Corp., Buffalo, N. Y.

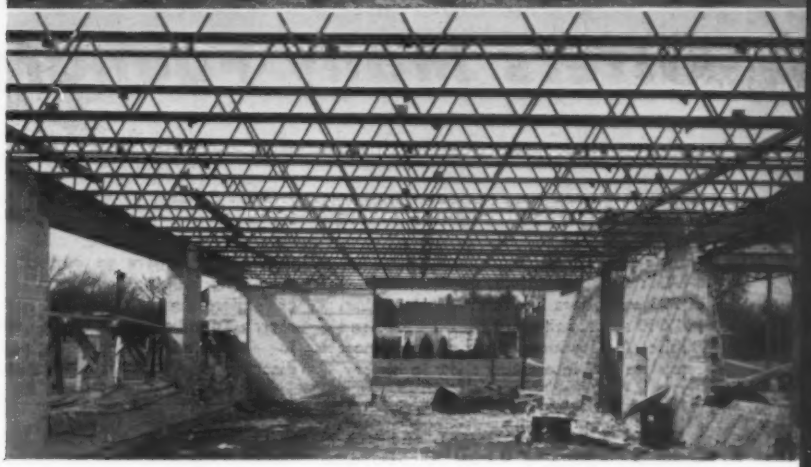
Addressing the Western New York Chapter of AFS at its February meeting in Buffalo, Mr. Cowlin said that the balance of sales was comprised mostly of vitrified bonded wheels, with some rubber, silicate, and oxychloride included.

The grinding wheel industry, he claimed, methodically is attempting to produce wheels that will perform more work without increasing cost. Although the industry is making a constant effort to reduce grinding costs, it constitutes an expanding field, Cowlin said.

How to Obtain Greater Grinding Economy

Cowlin suggested 14 possible means for effecting economy in grinding operations:

1. Select wheel hardness compatible with good grinding costs.
2. Use thinner wheels in certain applications where they will perform the same amount of work as thicker types.
3. Maintain surface speed through speed changes, or provide additional machines to use partially worn wheels.
4. Take advantage of large hole allowances in resin wheels. It might pay to install adapter flanges.
5. Use a template for measuring worn wheels before removal.
6. Substitute an aluminum oxide wheel for silicon carbide in a non-ferrous foundry, or where gray iron or hard malleable iron is to be ground.
7. Where portable cups are used, try a wider rim for the same price, or a straight-sided cup might prove practical.
8. Sometimes a dual specification wheel can be used effectively but the advantage must be carefully weighed against the cost.
9. Use a magnetic chuck to hold steel castings while swing grinding. Reduced vibration may cut wheel cost.
10. Hard-sided wheels at slightly higher cost might be justified for grinding brake shoes and other castings where work is mostly corner grinding.
11. Employ wheels which have been treated with materials such as wax, particularly on brass and aluminum. The added charge for treated wheels should prove economical in the long haul.
12. Unless castings have some dressing action, occasional dressing of wheels can be economical and a safety measure.
13. Wheel truing also adds to safety and restores normal contours of worn wheels.
14. Where large vitrified wheels are used, investigate the advisability of converting to resin wheels for increased operating surface feet per minute, and a tougher wheel.



(Right above) New AFS headquarters building had begun to take definition from the pile of excavated dirt and brick when this mid-February photo was taken from northeastern corner. Front of structure is shown at right, location of executive offices and library, which will occupy central area at far right. (Right below) Looking north from rear of west wing past area which will house magazine staff and safety and hygiene director. Reception lobby and main entrance of building will be located inside far end.

AFS Construction Accelerated

CONSTRUCTION on the AFS headquarters building and Foundry Technical Center at Des Plaines, Ill., was well ahead of schedule by the end of February.

All exterior steel work had been finished with only minor interior installations to be made. The gypsum roof planks had been mounted and the entire roofing operation was to be finished by March 3. The heating boiler was completely installed, as was the rough plumbing leading from the boiler room.

Electricians were installing conduit for the interior electrical system. Air conditioning ducts were to be in place before the middle of March. The concrete floor slab had been poured over the boiler room, with all the flooring set for completion by March 15. By the same date, all exterior brick work was to be finished. All stone work had been installed, as were the wooden eaves on the outside facings. The driveway leading to the parking area, on the west of the building, had been completed, along with the curbing on the west alley line.

While rapid progress was being made in construction, the AFS building fund was augmented further during the period, January 26-February 23, reaching $230,000 by the latter date.

continued on page 118

(Left above) Steel workers form silhouette against winter sky as welding proceeds on roof of AFS headquarters and Foundry Technical Center. (Left below) Much of brick and most of steel fabrication had been completed when this view of east wing was taken.

Largest AFS Convention and Show Offers Many Foundry Attractions

JUST over one month from show time, the 1954 AFS Convention and Foundry Exhibit has smashed all previous records.

With the list still incomplete, a total of 293 exhibitors has reserved more than 101,000 sq ft of the multi-level Cleveland Public Auditorium, ensuring the most complete and interesting show in history.

BOTH THE PRACTICAL and technological aspects of metals casting will be fully covered in the Convention's 42 technical sessions, 10 shop courses, and 8 round-table luncheons. About 100 of the ablest experts in the industry will participate in this program.

THE MORE THAN $3 million worth of materials and equipment will be exhibited by firms from 22 U.S. states, coast to coast, and two European countries. At least 57 of these companies will be exhibiting for the first time at an AFS show.

THE ANNUAL BANQUET, one of the high points of the Convention, will be held in the Auditorium at 7 pm, Wednesday, May 12. In addition to presentation of medals and other awards, a sparkling entertainment program is being arranged. Reservations should be made early.

THE GRAY IRON DIVISION'S ROUND TABLE luncheon will feature the latest developments in European foundry practice. Three participants in the 1953 International Foundry Congress in Paris will discuss European molding, coremaking, production equipment, melting practice, and metallurgy.

APPROXIMATELY 20% OF ALL EXHIBITS at this Show will be operating. Demand for electricity, compressed air, water, drainage, ventilation, and other facilities has been heavy.

ALL MEMBERS of the National Castings Council will have fully-manned booth and headquarters space at Cleveland.

THE STEEL DIVISION is sponsoring a session on hot tearing of steel castings. This meeting will mark the first public report on current AFS research work being carried on by a group of cooperating foundries and Armour Research Foundation. Problems on hot tearing submitted by steel foundries will be discussed.

THE PUBLIC AUDITORIUM is admirably equipped for an industrial show of this type. Visiting foundrymen will find ample rest rooms, telephones, even a first aid room with nurse. Refreshment counters will serve sandwiches, coffee, pie, and cold non-alcoholic beverages. One will be located in the Auditorium, one between the Auditorium and the North Hall, and one in Upper Lakeside Hall.

EXHIBITS WILL OPEN on Saturday morning, May 8, which is "Northeastern Ohio Day," providing free admission to employees of plants in the Cleveland area. The Show will be closed on Sunday, will reopen Monday morning, May 10, and run all day, closing at 5:30 pm. It will then remain open each day, closing at 1 pm. on Friday, May 14. On Wednesday, May 12, the Show will open at noon because of the Annual Meeting in the morning.

THE ANNUAL BUSINESS MEETING, Wednesday morning, May 12, will include the induction of newly elected national officers and directors, and presentation of awards to winners of the Apprentice Contest. Immediately following, Harry W. Dietert will present the Charles Edgar Hoyt Annual Lecture. His subject: "The Processing of Molding Sands" will cover fundamentals and results of latest research, as reported by one of the foremost authorities in the sand field.

FOREMEN AND OTHER OPERATING PERSONNEL should be particularly interested in a scheduled shop course on the melting and annealing of malleable iron. This Malleable Division meeting will include, in addition to metallurgical fundamentals, four major topics: melting and chemical composition, annealing equipment, control procedures, and pearlitic malleable.

AS THE NATIONAL ECONOMY recedes from the high tide of defense production, foundrymen will have to shore up their positions in the market, institute new research, effect those long-desired economies, stop small cost leaks. The Convention and Exhibit is the most prolific source for helpful information.

THE REFRACTORIES COMMITTEE is sponsoring a shop course with an expert panel to answer questions. Refractories in their foundry application will be discussed in all phases.

HEAT TRANSFER session will yield much valuable data on solidification phenomena. Risering, feeding range, pressure tightness, and hot tearing will be on the agenda, as experts show foundrymen how to increase casting yield, decrease costs.

"WHAT'S IN THE FUTURE?" is the working theme of the Sand Division round table luncheon. The program is designed to acquaint members with some of the investigative work contemplated by various committees. Chairmen of committees will report and the meeting will be opened to suggestions and discussion. Each of the six sand division technical sessions will cover one significant phase of sand technology: fundamentals, preparation, molding methods, core practice, surface finish, and development.

Combined Receptions

The President's Reception will be held jointly with the International Reception and Reunion. Time: 5:30-7 pm; Place: Hotel Cleveland. Invited guests are all AFS Past Presidents, present and incoming Board members, representatives of National Castings Council, all foreign attendance, Northeastern Ohio Chapter officers and directors, and those who attended the International Foundry Congress in Paris last September. Ladies are welcome.

AFS PATTERN DIVISION will sponsor a special exhibit of patterns and castings.

MOST CONVENTION TECHNICAL PAPERS will be preprinted, except those appearing in AMERICAN FOUNDRYMAN. Members should have already received order forms for preprints, which are available to them without charge. Others will be able to buy them at the Convention as long as the supply lasts.

ALL CHAPTER EDUCATIONAL CHAIRMEN will be invited to attend the Educational division program, which will introduce for the first time the new AFS Educational Director, Ashley B. Sinnett, formerly instructor in foundry at Michigan State College. The program is designed to develop integrated educational activities at the chapter level and broaden the work of the division in general.

Refractories Shop Course

For the first time, a shop course on refractories will be held at the Convention. It will be designed to emphasize to foundrymen the importance of refractories as a raw material, and to review fundamentals and recent technical developments of interest.

A panel of experts will answer questions on foundry refractories as used in the following applications: electric furnaces for both steel and non-ferrous melting, open hearth and reverberatory furnaces, cupolas, crucible furnaces, and auxiliary equipment.

Questions are invited by R. H. Stone, Vesuvius Crucible Co., Swissvale, Pa., who will act as moderator for the panel. Send them to W. R. Jaeschke, Whiting Corp., 157th St. & Lathrop Ave., Harvey, Ill.

THE ANNUAL ALUMNI DINNER will be held at the Union Club for all present and former national AFS officers. The social hour begins at 6 pm, dinner at 7. There will be no formal speaking program. Here is the opportunity to get together and meet old friends and associates.

SAFETY, HYGIENE & AIR POLLUTION sessions will feature papers that cover completed chapters of the forthcoming manual on "Foundry Health, Dust and Ventilation Problems." New information will also be presented on exhaust ventilation principles, and maintenance and testing of equipment. Separate meetings will be devoted to health, safety, and air pollution control.

PRODUCT AND SERVICE EXHIBITS will reflect newest developments in foundry operation and technology, including increasing trend toward mechanization and automation.

GRAY IRON DIVISION will sponsor five technical sessions, covering such subjects as calcium carbide injection, effect of graphite flake size on tensile and fatigue properties, acid cupola melting variables, and nodular iron. Shop courses will examine the use of high carbon pickup coke in cupolas, gating to control pouring rate, and cupola bed practice.

THE PLANTS VISITATION PROGRAM will be unusually attractive, since Cleveland is one of the metals casting centers of the nation. Many foundries in the area will provide visitors an opportunity to see working plants that include some of the most modern and highly mechanized installations in the world. This program will be a fine complement to the foundry equipment and materials exhibit.

FEATURING A SERIES of papers on titanium castings, the Light Metals Division will also present speakers who will discuss die casting alloys and centrifugal castings.

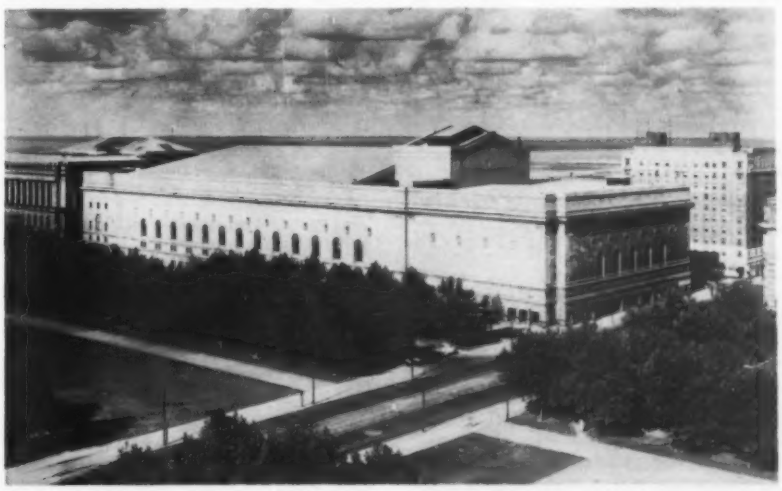
THE 1954 APPRENTICE CONTEST will be the largest of its kind ever held by AFS. There are 12 chapters sponsoring local contests: Birmingham, Detroit, Eastern Canada, Metropolitan, Michiana, Northeastern Ohio, Northern Illinois-Southern Wisconsin, Northern California, Southern California, St. Louis, Twin City, and Wisconsin. The Detroit Chapter has the largest number of entrants of any of the chapters, listing 31 contestants in the wood pattern division, 32 in metal pattern, none in molding.

PATTERN SESSIONS will include papers on shell molding pattern equipment and use of plastics in patternmaking. Blowing core driers will be the topic of another presentation and discussion period.

THE LADIES' COMMITTEE has tentatively scheduled its program for wives of visiting foundrymen. The official tea will be held on Monday, May 10, with music provided by a trio. Festivities move to the Alpine Village on Tuesday, May 11, where luncheon will be followed by a complete program of stage and TV stars. Prizes will be distributed. Another luncheon will be held—Thursday, May 13, at the Westwood Country Club. Full details on all of these functions will be available in the May issue of AMERICAN FOUNDRYMAN.

SO MANY EXHIBITORS have reserved space at Cleveland that it became necessary to open up an area in the Arena. Applications have continued to come into National Headquarters. This supplementary list includes only those accepted since the March issue of AMERICAN FOUNDRYMAN went to press.

Cone-Drive Gears Div., Michigan Tool Co.	Detroit
Gamma Industries, Inc.	Baton Rouge, La.
Technical Operations, Inc.	Arlington, Mass.
A. P. Green Fire Brick Co.	Mexico, Mo.
Automatic Foundry Equipment, Reichert, Inc.	Newark, N. J.
J. Hannan Co.	Cleveland
Gladwin Corp.	Wyandotte, Mich.
Metco Processing Corp.	Wyandotte, Mich.
Porter-Cable Machine Co.	Syracuse, N. Y.
Wood Fabricating Co.	Dearborn, Mich.
Maschinenfabrik & Eisengiesserei Kallnach	Kallnach, Switzerland



Cleveland Public Auditorium will be site of largest AFS Convention and Show, May 8-14.

Convention Paper Abstracts

Convention Paper Abstracts

Convention papers available to AMERICAN FOUNDRYMAN at press time are abstracted below. Preprints of most papers will be available at no cost to AFS members by April 1 and may be requested by using the special preprint request form which was mailed to all Society members the middle of March.

Gray Iron

54-1 . . "Graphitization of Certain Fe-C-Ti Alloys," A. B. Beach, General Electric Co., and R. W. Heine, University of Wisconsin. Certain Fe-C-Ti alloys were studied to determine the nature of the stable system and the alloying behavior of titanium in white cast irons in the malleable iron composition range. Work shows that titanium promotes equilibrium structures with graphite, ferrite, and TiC as phases present after heat treatment. Being entirely a former of TiC, titanium thus shows that it is not necessary for an element to dissolve in ferrite to promote graphitization of iron carbide in ternary Fe-C alloys. Since the titanium is tied up as a carbide, no hardening or strengthening effects on the ferrite can be expected.

54-6 . . "Theoretical Aspects of Oxygen in Cast Iron," B. B. Bach, British Cast Iron Research Association. Thermodynamic treatment of reactions between carbon, silicon, manganese, and phosphorus when cast iron is melted shows that qualitatively, at least, the effects of temperature, pressure, carbon, and silicon on the oxygen content can be predicted. Analysis of data shows that oxygen increases with temperature at constant carbon content and constant partial pressure of carbon monoxide; also increases with P_{CO} if carbon and temperature are constant. Silicon lowers the oxygen content of iron; oxygen content of Fe-Si-O alloys increases with increasing temperature; silicon reduces the activity of oxygen in Fe-si-O alloys. Manganese reduces the oxygen content of iron; increase in temperature at constant manganese content increases the oxygen content. Data for phosphorus are not extensive but lead to conclusion that phosphorus lowers the activity of oxygen and might even increase the oxygen content.

54-8 . . "Calcium Carbide Injection—A New Foundry Tool," J. M. Crockett, Air Reduction Sales Co., and H. E. Henderson, Lynchburg Foundry Co. Finely divided calcium carbide injected into molten iron by means of dry nitrogen removes sulphur, permits use of more economical alloy additions, and provides a base for conversion to spheroidal graphite. Conversion can be made through injection. (See pp. 34-43 this issue.)

54-20 . . "Effect of Graphite Flake Size on Tensile and Fatigue Properties of Gray Cast Iron," R. W. Lindsey, Pennsylvania State University, and J. H. Hoke, Johns Hopkins University. Inoculated and uninoculated irons were cast in different section sizes to get different graphite flake sizes, then heat treated to secure an identical matrix. Specimens were tested for tensile strength, fatigue, modified bend, and damping capacity. Increasing graphite flake size decreases tensile strength, apparent modulus of elasticity in tension, and endurance limit. Tensile strength was decreased about 25 per cent and endurance limit was decreased about 35 per cent when flake size was increased from Size 5 to Size 3.

54-22 . . "Some Variables in Acid Cupola Melting," Sam Carter and Ralph Carlson, American Cast Iron Pipe Co. Report on attempts to quantitatively correlate various effects of more prominent variables encountered in acid cupola operation in an effort to bring cupola performance under more scientific control. Variables studied in 45 experimental heats in a 23-in cupola were: coke size and distribution, coke quality, air volume, and size and shape of steel scrap. Effects correlated and graphed are sulphur absorption, carbon pick-up, oxidation loss, slag composition, melting rate, and stream temperature. Most of the principles developed are verified with experiences on production cupolas of larger size.

54-28 . . "Importance of Cooling Rate of Physical Properties of Gray Cast Irons," Jules Henry, Forest City Foundries. Tendency to think of cooling rate in terms of section size alone can lead to apparent anomalies in hardness and other properties of cast iron. Hot shakeout, for instance, can lead to higher hardnesses in heavier sections if the latter are above the lower critical when released from the sand. Several tests are presented to show that properties of gray cast iron can be changed by as much as 25 per cent when moderate changes are made in the speed of cooling through the lower critical.

54-32 . . "Fluidity vs. Core Blows in Automotive Gray Iron," Allen A. Evans, International Harvester Co. Gas inclusions and porosity trends can be predicted by measuring iron fluidity with a new test. (See pp. 66-68 this issue.)

54-40 . . "Risering of Nodular Iron," R. C. Shnay and S. L. Gertsman, Physical Metallurgy Div., Department of Mines and Technical Surveys of Canada. Study was conducted to develop quantitative data on risering of nodular iron. Results show: feeding requirements of nodular approach those of steel castings; minimum riser height needed to eliminate under-riser shrinkage at maximum feeding distance is less than 1½ riser diameter for ½-1½-in. plates and varies with plate thickness and possibly riser diameter; feeding requirements of ½ and 1-in. plates appears to be fairly insensitive to composition fluctuations as encountered in the study.

54-54 . . "Methods for Special Pipe Production in Australia," G. J. Benson, Melbourne Technical College. Production of large gray iron pipe and fittings for irrigation in Australia are described. Step by step explanation of method for strickling five-ton faucet tee and 3.4-ton elbow are given, including casting of hold-down plate and core arbor. AMERICAN FOUNDRYMAN, March 1954, pp. 63-67.)

54-67 . . "Melting Cast Iron Borings and Steel Turnings in the Cupola," Wm. Y. Buchanan. Details of series of trials, some successful, some not, carried on over nearly 30 years by the author to take advantage of comparatively small melting stock available from time to time. He agrees the cupola works best with uniform materials, sized in proportion to the diameter of the cupola, but concludes that this furnace will melt any ferrous metal from the full size of the charging door down to the smallest form of drilling or cutting. (Will appear in May issue.)

54-74 . . "Relationship of Carbon Equivalent to Properties of Cast Iron," Warren C. Jeffery, Eugene E. Langner, Jr., Woodfin G. Mitchell, and Ghulam D. Azizi, University of Alabama. Two series of heats were poured with carbon equivalent ranging from 2.95 to 4.90 per cent at two phosphorus of approximately 0.20 and 0.75 per cent. Specimens for shrinkage, fluidity, hardness, chill, and transverse tests were poured. Mechanical properties, composition, and microstructure were determined. Based on the findings, which the authors list in detail, it is concluded that the formula for carbon equivalent, $CE = \%TC + 0.3(\%Si + \%P)$, can be used to estimate the properties studied from chemical composition.

Sand

54-2 . . "Effect of Moisture Content on Silica Sand," E. D. Sayre, General Electric Co., and C. T. Marek, Purdue University. More precise sand control is possible through a better understanding of the influence of moisture. Accordingly experiments were conducted to determine the effect of moisture on bulk density, mold hardness, and compressive strength of four sands, each graded to a single, different screen size. It was determined that sand bulk density decreases to a minimum as water is added, then increases, approaching a maximum near the point of inundation. Hardness and compressive strength increase accordingly, and approach a constant maximum as moisture content increases. Corresponding to a decrease in grain size, the minimum bulk density drops and a greater maximum strength and hardness develops.

54-15 . . "Improving Surface Finish on Gray Iron Castings," W. G. Parker, General Electric Co. Application of oil-sand

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(Left) Some of the foundrymen broke into song at the President's dinner of the Wisconsin Regional Conference. (Right) Here (from left) are: Wisconsin Chapter President A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee; Conference Chairman R. V. Osborne, Lakeside Malleable Castings Co.; and J. F. Schnur, International Department, Armour Research Foundation, Chicago, who spoke about his experiences in India at the Conference luncheon. Mr. Schnur's talk was titled: "Directing Foundry Operations From Elephantback in India."

Heavy Attendance At Wisconsin Conference

The 17th Annual Wisconsin Regional Foundry Conference is reported with the assistance of Wisconsin Chapter members under the direction of D. M. Gerlinger, Walter Gerlinger, Inc., Milwaukee. Photos are by Walter Napp, Delta Oil Products Co.

■ Heavy attendance again marked the Wisconsin Regional Foundry Conference as 621 foundrymen registered for the two-day meeting held February 11 and 12 at Hotel Schroeder, Milwaukee. They participated in a program of 20 technical sessions, two luncheon meetings, and a banquet arranged under the direction of Chapter President A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Conference Chairman R. V. Osborne, Lakeside Malleable Castings Co., and Program D. R. Hutchison, Nash-Kelvinator Corp.

The conference started with a general meeting at which speakers were AFS National President Collins L. Carter, Albion Malleable Iron Co., Albion, Mich., Engineering Dean Kurt F. Wendt, University of Wisconsin, and Walter F. Scholtz, Allis-Chalmers Mfg. Co. Mr. Pfeiffer opened the conference and introduced Mr. Carter who complimented Wisconsin Chapter members on their annual meeting, saying that it adds to AFS prestige.

"What makes AFS tick?" Mr. Carter asked, then answered his own question by outlining the society's technical research, and publishing activities. He paid tribute to the national committee members who carry on the technical work of the organization. The new AFS headquarters would be ready for occupancy in early summer, he said, pointing out that the building would provide the United States with its first foundry tenchical center such as has long existed in Europe.

Prof. George J. Barker, University of Wisconsin, associate chairman of the conference along with Prof. E. R. Shorey, introduced Dean Wendt. The United States thrives on optimism, Dean Wendt said, in directing attention to the country's advance in commerce, industry, and health. Education and research are the keys to progress, along with optimism and confidence, he concluded.

"Combating the Effects of Noise" was Mr. Scholtz's subject. He described his company's program for studying industrial sounds and their possible effects on employees. First step in the program was a plant survey to determine how much noise there was and where it originated. All new employees plus those in high-noise areas were given audiometric examinations, he said, including a study of their past work record and ability to hear under various conditions. He advised otoscopic examination also, and recommended including audiometric examination in periodic physical checkups, if given. All employees should eventually be covered.

Employees with significant loss of hearing may have noise-susceptible ears, Mr. Scholtz declared. They should be given best possible hearing protection and sent to a competent otologist for further study. The company's four noise abatement committees, he said, are made up of shop supervision and maintenance personnel. In the absence of noise abatement standards, the committees started work in the noisest shop areas, replacing loose gears and bearings, establishing sound-proof cubicles for noisy operations like blowing chips with compressed air, replacing sheet metal guards with wire mesh guards, installing mufflers on air vises, and covering metal bench tops with wood.

One plant is experimenting with automobile undercoating for metal boxes and tumbling barrels, Mr. Scholtz stated. He cited an instance to illustrate that indiscriminate use of acoustical material without competent acoustical engineering will not always reduce noise significantly.

Technical or Human Progress

At the first luncheon meeting, Mr. Osborne presided; speaker was Hans J. Heine, AFS technincal director. The speaker said it is a paradox that so much technical progress has been made while so little seems to have been accomplished in the field of human behavior. Mr. Heine suggested that too much reliance was being placed on the written and spoken word, and too little on thinking.

Speaker at the banquet the evening of the first day, David P. Livingston, Washington, Iowa, assured his listeners that those who depended on farm prosperity for sale of castings could view the future with confidence. Farmers are not buying at present, he said, but they have money and will spend it on farm equipment come green-up. Mr. Pfeiffer presided at the banquet.

John F. Schnur, International Dept., Armour Research Foundation, described his experiences in India, where he has spent several years assisting Indian foundrymen, at luncheon the second day. Conferences Co-Chairman P. C. Fuerst, Falk Corp., was luncheon chairman.

Mr. Schnur said he'd visited 138 of the 1800 foundries of India and found

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Many Foundrymen Attend Southeastern Conference

ABOUT 450 foundrymen comprised an overflow audience at the 22nd annual Southeastern Regional Foundry Conference. Held February 18-19 in the Chattanooga (Tenn.) Patten hotel, the meetings were co-sponsored by three AFS groups: Tennessee, Birmingham District, and University of Alabama Student Chapters.

The Conference was under the General Chairmanship of Paul L. Arnold, U. S. Pipe & Foundry Co., Chattanooga. Committees were headed by the following: *Finance:* W. H. Hamilton, Crane Co., Chattanooga; *Program:* C. S. Chisholm, Wheland Co., Chattanooga; J. A. Wickett, U. S. Pipe & Foundry Co., Birmingham. Ala.; *Printing*: C. A. Fischer, Jr., Fischer Supply Co., Chattanooga; *Registration & Arrangements:* Herman Bohr, Jr., Robbins & Bohr, Chattanooga; W. K. Bach, Foundry Service Co., Birmingham; *Publicity*: Frank Robbins, Jr., Robbins & Bohr, Chattanooga; J. C. Vaught, McWane Cast Iron Pipe Co., Birmingham; *Plant Visitation*: K. L. Landgrebe, Wheland Co., Chattanooga; *Greeters & Entertainment:* Porter Warner, Jr., Porter Warner Industries, Chattanooga; Don C. Abbott, Hill & Griffith Co., Birmingham; and V. I. Byford, Production Foundries Div., Jackson Industries, Inc., Birmingham.

Explains Cupola Operation

Gosta Vennerholm, Ford Motor Co., Dearborn, Mich., presented the first paper: "New Trends in Cupola Operation." Chairman was J. E. Reynolds, U. S. Pipe & Foundry Co., Bessemer, Ala., Mr. Vennerholm presented excellent information on the operation of the conventional acid-lined cupola. He then showed slides and discussed charging methods and operation of special cupolas. He explained how products of combustion from the recuperator raised air temperature to 600 F maximum; and how the coarser products of combustion are dropped to a hopper at the bottom of the recuperator, the remaining exhaust gases being conditioned and discharged through an electrostatic precipitator. His slides demonstrated side and top charging with a closed-top cupola.

Mr. Vennerholm then described new developments in cupola design and their effects on metallurgical reactions. There are four factors which, once established, will resolve the problems created by new and increased demands on the cupola. He listed them as:

1. The ability to meet analytical specifications with low cost raw materials, such as scrap iron or steel.
2. The ability to perform desulphurization regardless of the raw materials.
3. The ability to control oxidation to a point of minimum metallic losses as may be required in the manufacture of new special-purpose cast irons.
4. The ability to operate over extended periods without requiring internal repair.

The modifications to operational technique and design on special cupolas must be in a direction which will permit a concentrated combustion zone able to produce very high temperatures, complete freedom in formulating the slag composition, maintaining the slag depth at a constant predetermined level, continuous tapping, and extended operation unhampered by present refractory limitations.

Seek Lowest Costs

Chairman of the next session, Tom Alford, Wheland Co., Chattanooga, introduced C. A. Sanders, American Colloid Co., Chicago, whose paper was titled, "Current Trend in Molding Sand Mixtures for Foundry Use." At present, he said, competition is forcing most foundrymen to consider their lowest cost of molding and melting. It is time that they considered all points in order to improve the quality of castings to meet the continual pressure for price concessions that accompany a buyers' market. For this reason, he suggested, they should first determine if their operations are working at the most efficient level. In his opinion, all processes must originate with the same base sand, so cost figures cannot be properly established unless the consideration of grain fineness is first established.

There is a strong trend, Sanders continued, to force foundries to do better with what they have. That means use of finer sands, less bond in the mixture, less water, less combustible materials, and more mulling, which is highly preferable over a simple mixture. The finer base sand means better quality finish, and a closer controlled and supervised molding mixture means more or better castings per dollar spent. Sanders accompanied the talk with colored slides showing 37 different types of defects that are not curable by changing or altering the molding sand or molding practice.

The luncheon was enjoyed by an overflow audience of over 200 foundrymen, who heard the Hon. P. R. Olgiata, mayor of Chattanooga, welcome them to the city. He complimented the foundry industry on its achievements in the city and mentioned that it was the second largest industry in Chattanooga.

National AFS Vice-President, Frank J. Dost, reviewed the achievements of the Society. He indicated to the members where their money was being spent —for research, education, and publication of materials for the foundry industry. W. W. Maloney, AFS Secretary-Treasurer, advised the members of progress made in planning for the 1954 Convention at Cleveland. From all indications, he said, this would be the largest meeting ever held by the Society.

Incentives For Supervisors

The afternoon sessions were opened by C. J. Pruet, McWane Cast Iron Pipe Co., Birmingham. His subject was, "Supervisory Incentives." The chairman of this session was N. D. Neptune, National Cast Iron Pipe Co., J. B. Clow & Sons, Tarrant City, Ala. Mr. Pruet contended that the supervisory force is the backbone of any well-managed organization, and that this was especially true where the firm uses a wage incentive plan for production and maintenance employees. He detailed how the supervisor has direct control of production and that the incentive plan should be based directly on savings in operating costs, improved quality, and similar factors. The entire program of incentives must be based on the principle of reward for results. He also outlined details for determining factors upon which to base incentive earnings, and gave the advantages of measurement of the incentive plan by time study analysis.

There was considerable discussion following the presentation of this paper and AFS Vice-President Dost entered the discussion and gave some valuable pointers on inciting the foundry supervisory team to work together.

The Chairman of the next session, Walton Coleman, Southern Shell Mold Equipment Co., Chattanooga, introduced J. H. Smith, Central Foundry Div., General Motors Corp., Saginaw, Mich. Mr. Smith spoke on "Shell Molding and Methods Engineering," answering many questions on shell molding processes and on time study procedure to improve operating practices. He presented film in two sections, showing shell mold operations and methods engineering practices as carried out at his organization.

H. M. Barker, U. S. Pipe & Foundry Co., Chattanooga, Chairman of the next session, introduced C. E. Wenninger, National Engineering Co., Chicago, who presented a paper on "Developments in Foundry Sand Reclamation." He reviewed the historical development of sand reclamation, then discussed the fun-

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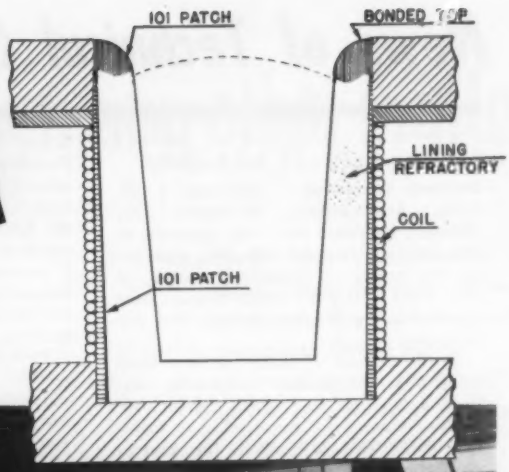

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News of Technical Committees

Safety, Hygiene & Air Pollution

Steering Committee. Chairman J. R. Allan, International Harvester Co., Chicago, presided over this meeting in Chicago on January 20. He reported on the annual convention program of the three division committees: Dust Control & Ventilation, Safety, and Air Pollution.

J. G. Liskow, chairman of the Dust Control & Ventilation Committee, outlined a proposal to prepare the sections of their manual for publication in loose-leaf form, and to publish the several chapters as they are completed. Various sections were reviewed and corrections and additions recommended.

In the afternoon, a general discussion was held on policy regarding contents of publications the committee would be required to approve. Certain procedural details for the handling of submitted material were determined.

Dust Control & Ventilation Committee. A meeting was held on January 21 at Chicago, with J. G. Liskow, American Air Filter Co., Inc., Louisville, Ky., in the chair. Principal topic was the committee's participation in the Convention technical program. Session for this group is scheduled for Tuesday, May 11, at 2 pm.

It was suggested that the Michigan State Industrial Hygiene Department stage a demonstration of local exhaust, which would be superior to verbal presentation. A. S. Lundy, Claude B. Schneible Co., Detroit, agreed to contact that agency in order to make arrangements.

The committee then continued work on review of manual material, much of which had been done by the division Steering Committee on the previous day.

Sand Division

Committee 8-J. This committee on the physical properties of iron molding materials at elevated temperatures met at Cleveland on January 20. E. C. Zirzow, Werner G. Smith, Inc., Cleveland, served as acting chairman until a new panel of officers was elected. These were: chairman, R. L. Doelman, Miller & Co., Chicago; vice-chairman, E. J. Passman, Frederic B. Stevens Co., Detroit; secretary, W. A. Spindler, University of Michigan, Ann Arbor.

With the new chairman presiding, the committee discussed whether high pressure molding should be investigated. The vote was negative, the members indicating that the new method is not yet fully established in the industry.

A decision was made to do further work on scabbing as the next committee project. This procedure was adopted because ". . . the veining investigation is held up by delay in the development of required test procedures . . ."

Future meetings were set up for February 26 at the University of Michigan Foundry in Ann Arbor, where current officers of the committee, the past chairman, and representatives from the Harry W. Dietert Co., Detroit, and from the university, would be present. An April 5 meeting would be held, also at the university, since the cast metals laboratory would be available because of spring vacation.

Following luncheon intermission, a specific program on scabbing was adopted for the April meeting. Three test series of castings were to be made, using sand mixtures as indicated. Laboratory testing of sand mixtures would be performed by the Dietert Co., and volunteer checks by Charles Morrison, Dayton Malleable Iron Co., Ironton, Ohio; G. F. Watson, American Brake Shoe Co., Mahwah, N. J.; R. E. Wilke, American Radiator & Standard Sanitary Corp., Louisville, Ky.; and Roy Korpi, Ford Motor Co., Dearborn, Mich.

Malleable Division

Controlled Annealing Committee. Having been on an inactive basis since 1950, this committee held its first meeting since reactivation in Chicago on February 8. Eric Welander, John Deere Malleable Works, East Moline, Ill., presided as chairman.

Purpose of the meeting was to organize the Malleable shop course for the forthcoming AFS Convention in Cleveland.

The consensus of the members was that the Cleveland session should be a panel discussion without the reading of formal papers. It was felt that opportunity should be allowed to discuss several papers presented at previous technical sessions. Further, it was thought that the restatement of the metallurgical fundamentals concerning the annealing of malleable iron could act as a stimulus to subsequent discussion. Hope was expressed that the title "Shop Course" would bring out many foremen and other operating personnel, particularly from small shops.

It was further agreed that the panel consist of five committee members, with the chairman acting as moderator for the session. It was suggested that the moderator ask questions of the panel, and that the projected discussion should be prepared in advance of the Convention.

Casting Institute Reprint

Alloy Casting Institute has announced the availability of reprints of a paper presented at the ninth annual conference of the National Association of Corrosion Engineers. Entitled "Corrosion by Aqueous Solutions at Elevated Temperatures and Pressures," the paper was authored by Dr. F. H. Beck and Dr. M. G. Fontana, both of Ohio State University. It is the result of a continuing study of corrosion under A.C.I. sponsorship by the two educators. For copies, write the Institute at 23 Third Avenue, Mineola, New York.

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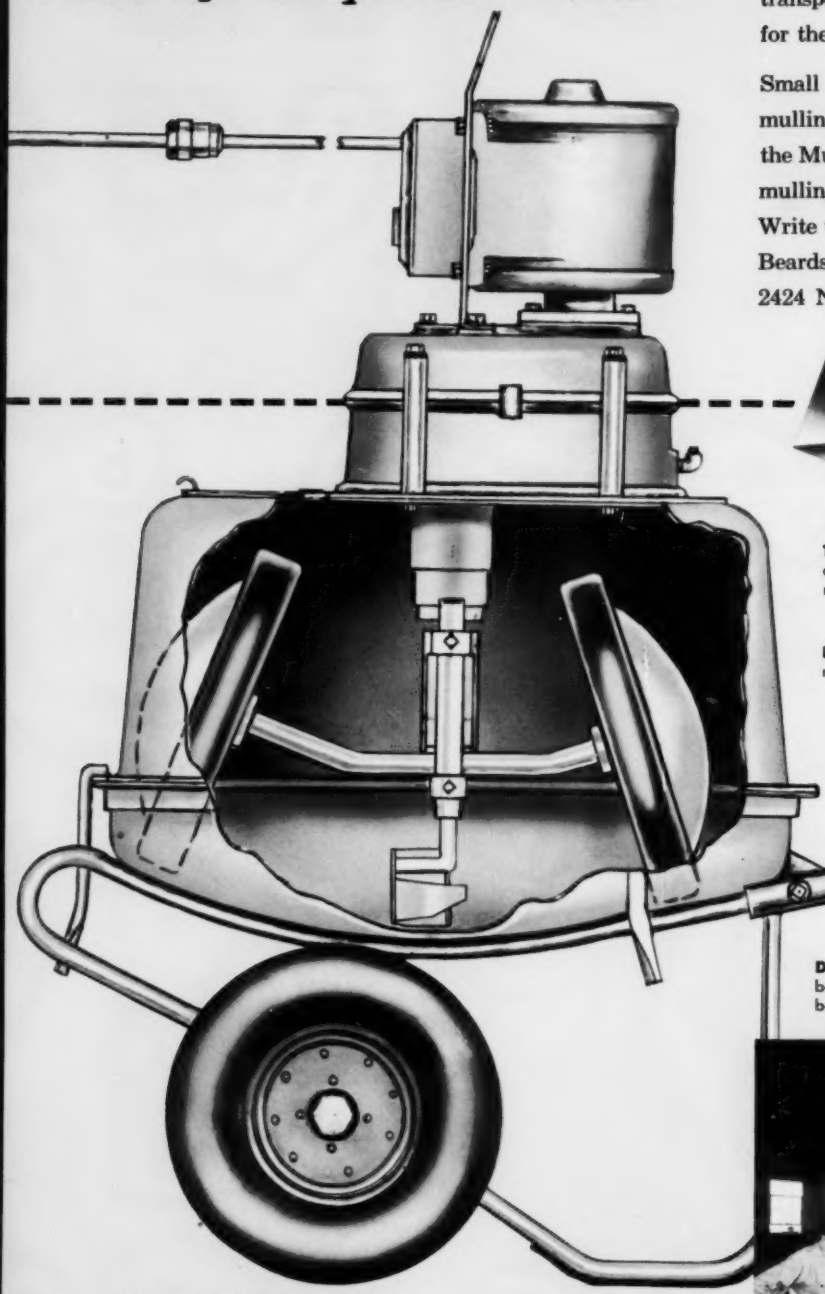

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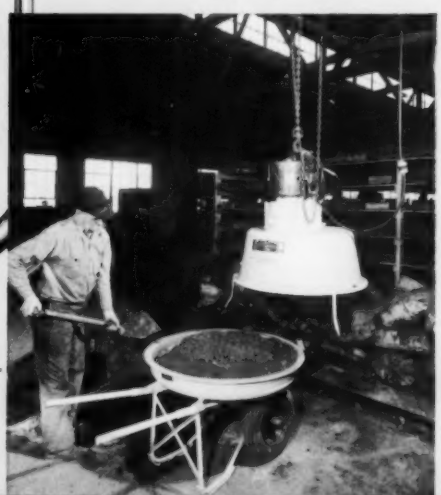

Less sand handling! Handle the sand once when it's loaded for mulling . . . then deliver it to molder or coremaker in the same barrow.

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Attending the January meeting of the Southern California Chapter from left to right: Harold G. Pagenkopp, Angelus Pattern Works; Dominic Meaglia, American Foundry; Walter R. Jaeschke, Whiting Corp., guest speaker; Richard and Frank Meaglia, American Foundry. *Photo K. F. Sheckler, Calomo Engineering Co.*

Chapter News

Just Four Months Left

With Membership in the American Foundrymen's Society as of February 28 at 11,435, a total of 565 new members are needed to meet our goal of 12,000 members by June 30 of this year. Membership showed a drop of 88 over the January 31 total. With just four months to go, let's get behind our membership chairmen and meet our targets before the June deadline. During February seven new company members and one sustaining member have been added to the rolls. They are:

Company Members

A.A.A. Machinery & Equipment Co., Cleveland; Daniel Richman, Partner. (Northeastern Ohio Chapter).

Acheson Mfg. Co., Rankin, Pa.; O. Edwin Decker, Fdy. Supt. (Non-Chapter).

Curtiss-Wright Corp., Buffalo, N. Y.; V. T. Gorguze, Gen. Mgr. (Western New York Chapter).

Euclid Foundry & Equipment Co., Cleveland; H. Krogmann, Pres. (Northeastern Ohio Chapter).

Gerwin Industries, Inc., Michigan City, Ind.; A. L. Yeager, Pres. (Michiana Chapter).

Milwaukee Solvay Coke Co., Milwaukee; Albert P. Mueller, Gen. Supt. (Wisconsin Chapter).

Roth Smelting Co., Syracuse, N. Y.; Joseph Roth, Partner. (Central New York Chapter).

Sustaining Member

Rensselaer Valve Co., Troy, N. Y.; Lyman C. Thunfors, Pres. (Eastern New York Chapter) Conversion from Company.

Northwestern Pennsylvania

Northwestern Pennsylvania Chapter held its January meeting at the Erie Moose Club, Erie, Pa. Bailey D. Herrington, chapter vice-chairman, presided in the absence of Charles Gottschalk.

Guest speaker was Lawrence D. Pridmore, International Molding Machine Co., and his subject was "Core and Mold Blowing." He traced the methods to early times to show the many improvements that have been made and where the addition of some simple gadget would decrease costs and increase output. He also stressed the location and proper size of core vents.

Earl M. Strick reported that there are now five film strips entitled "A Career in Metals" being used in the public and catholic schools of Erie. The February issue of *"The Erie Story,"* a monthly magazine, contains an article entitled "Foundrymen of Erie," written by Mr. Strick.

Erie Foundries of General Electric Erie Works presented the sound slide film, "Career in Metals," to the Lawrence Park School District. The purpose of the film, which was produced under the direction of Northwestern Pennsylvania Chapter, is to interest high school students in the foundry industry and acquaint them with some of the 300 different types of job opportunities available.—*Roy A. Loder.*

Canton District

The February meeting of the Canton District Chapter was held at the Barberton Elks Club, Barberton, Ohio. Thomas W. Seaton, American Silica Sand Co., was the guest speaker and his subject was "Traveling With A Grain of Sand." He showed color films describing the mining and processing of foundry sands and discussed the importance of proper specifications to be used in buying foundry sand.

Chapter Chairman, Robert A. Epps, presided and Alfred S. Morgan introduced the evening's speaker. Present at the meeting were 95 members and guests.

John J. Popa, American Steel Foundries, Alliance, Ohio, has been appointed a director of the Canton District Chapter. He replaces Loren L. Whitney, who has resigned. Mr. Whitney is no longer stationed in the Alliance plant.— *R. R. Kozinski.*

Southern California

The January meeting of the Southern California Chapter was held at the Rodger Young Auditorium, Los Angeles, Cal. Approximately 140 members and guests attended to hear Walter R. Jaeschke, Whiting Corp., Harvey, Ill., speak on "Cupola Operation and Mechanization." Mr. Jaeschke also showed slides and a sound movie further demonstrating practical ways of mechanizing the charging of cupolas. He stated the cupola is still the most practical and economical method of melting iron. A discussion followed and Mr. Jaeschke answered many questions regarding cupola operation.

James Oliva advised of the Ladies Night Dinner and Dance to be held Saturday evening, May 1, at the Pacific Coast Club, Long Beach, Cal.—*Otto H. Rosentreter.*

Philadelphia

The Philadelphia Chapter enjoyed an educational and informative meeting in January, in the form of a talk and film by Chester V. Nass, National AFS Director, and vice-president, Beardsley and Piper, Div. Pettibone Mulliken Corp. His film and narration on "Mechanization in Coremaking" was received by a group of over 200 members and guests.

A question and answer period led by Walter S. Giele, technical chairman for the evening, followed the speakers presentation.—*Charles R. Sweeny.*

Northeastern Ohio

Attracted by a dual technical program, over 250 members and guests turned out for the February meeting of the Northeastern Ohio Chapter at the Tudor Arms Hotel, Cleveland. In the absence of Chapter Chairman S. E. Kelly, the presiding officer was David Clark, Jr., chapter vice-chairman.

The general technical session, under chairmanship of Jack Kroecker, featured showing of the AFS film "Effect of Gating Design on Casting Quality." Introductory remarks were made by Walter E. Sicha, who also led the discussion which ensued.

The film was produced by Battelle Memorial Institute under guidance of the AFS Light Metals Research Committee. It is the third in a series of films showing pouring tests conducted with water in transparent lucite molds. The test molds utilized a gating ratio (area of sprue to runner and gate) of 1-4-4, rounded runner and gate corners, round or rectangular tapered sprue with top area three times that of the bottom area, rounded corners at junction of sprue and pouring basin, and pouring practice which avoided pouring directly down the sprue and kept ladle close to pouring basin.

The latest film deals with sprue base problem. The use of a vertical cylindrical well plus runner enlargement in the drag just under the sprue proved the best design in eliminating turbulence and entrapment of air into the mold.

Second of the technical sessions, conducted separately, was sponsored by the patternmaking division of the chapter.

Chapter News

Chairman was John F. Roth, Cleveland Standard Pattern Works, and the speaker was John M. Thompson, Sherwin Williams Paint Co., whose topic was, "What Research Offers in a Pattern Coating."

Mr. Thompson enumerated the characteristics a pattern coating ideally should possess and then, on the basis of a 5,000-hour research project conducted by his company, showed how a number of common types of coatings had measured up to them. These include such qualities as hardness; resistance to abrasion, prints, core binders, water, gasoline and other substances; gloss; drying properly, high solids content; brushability and unoffensive odor.—*Robert H. Herrmann and Jack C. Miske.*

Twin City

Otto H. Harer, Scientific Cast Products Co., Chicago, was the guest speaker at the February meeting of the Twin City Chapter. His subject was "Pattern Trends."

Mr. Harer's talk pointed out advances in pattern making techniques designed for high production shops. It was the speaker's opinion that for consistently fine casting production, the pattern maker must assume the duty of liaison between the engineer and the molder.

Some of the new developments which Mr. Harer pointed out concern the relatively new molding processes—the D Process for shell molding, Dielectric Baking, and Expanding Plastics Molds. The matching of shells for shell molding by incorporating grooves in the cope and matching beads on the drag; the sealing of core boxes to blowheads by the use of tongue and groove parting lines injected with plastic sealers represent some examples of progress in pattern development. Mr. Harer's talk was illustrated with slides.

J. W. Costello, American Hoist & Derrick Co., reported to the group that three pattern and two molding apprentices have been entered in the 1954 AFS National Apprentice Contest to be held during the Cleveland Convention in May.—*R. J. Mulligan.*

Texas

Some 51 members and guests of the Texas Chapter met in Beaumont, Texas, to hear J. Wesley Cable, The Girdler Co., Thermex Div., give a paper on

Left, Lawrence D. Pridmore, guest speaker at the Northwestern Pennsylvania Chapter meeting and Bailey D. Herrington, right, chapter vice-chairman.

William S. Pellini, Head Metal Processing, Naval Research Laboratory; Henry Felten, Peoria Malleable Castings Co., and Frank Shipley, Caterpillar Tractor Co., Peoria, Illinois, prior to Mr. Pellini's talk at the Central Illinois chapter meeting.

"Recent Advances in Dielectric Core Baking." Mr. Cable used a blackboard to illustrate and simplify this new technique of core baking. A discussion period followed the talk.

The East Texas Sectional Group held a sectional dinner meeting in Longview, Texas, January 22. W. M. Peterson, M. A. Bell Co., St. Louis, spoke on "Molding Sand Practice." Following his talk there was a showing of a film on mechanization from the Ford Motor Co. After presentation of this film there was a colored film showing a shell molding operation of the Tyler Metal Products Co., St. Louis, Mo., shell molder.

The January meeting of the Texas Chapter was held in Dallas, Texas. Hiram Brown, Solar Aircraft Co., Des Moines, Ia., was guest speaker and his subject was "Light Metal Foundry Practice. He supplemented his discussion with slides and chalk talk, with a question and answer session following. Following the meeting, Mr. Brown presented the group with reprints of his address.

—*Wm. A. Bearden.*

Washington

The February Dinner Meeting of the Washington Chapter featured a talk on "Mechanization in the Core Room" by AFS National Director, Chester V. Nass, Beardsley & Piper, Div. Pettibone Mulliken Corp., Chicago. A film "Mechanization in Core Making," and general discussion followed the talk.

Chapter Chairman, William L. Mackey, appointed James F. Dolansky, James Tracy and Stanley Marshall to the Nominating Committee.—*Harry Peltzer.*

St. Louis

"Spectroscopy in Modern Foundry Control" was the subject presented at the February meeting of the St. Louis Chapter. This new, rapid method of chemical determination was discussed by two well qualified speakers, Prof. Adolph Legsdin, Missouri School of Mines and Metallurgy, Rolla, Mo. and D. R. Moore, National Spectrographic Sales Corp., Cleveland, Ohio. Both speakers used slides to illustrate their talks, Prof. Legsdin outlined the basic apparatus and the principles of operation, while Mr. Moore described equipment available and the techniques to be followed for efficient operation.

Technical chairman for the meeting was John H. Culling. Complete information on the Spring Dinner Dance to be held May 1 at Norwood Hills Country Club was announced.

The chapter had an official visit of National Director, A. L. Hunt, National Bearing Div., American Brake Shoe Co., who reported on the activities at the national office.—*Jack Bodine.*

Detroit

The Detroit Chapter held its "Annual Castings Defects Clinic" at the February meeting.

Guests for the evening included professors Charles C. Sigerfoos and F. C. Flory; assistant professor D. G. Triponi, and eight student chapter members, all of Michigan State College. Also assistant professor William A. Spindler and six student chapter members of the University of Michigan.

Chapter Chairman, Harry E. Gravelin, now associated with Lincoln Mercury Div., Ford Motor Co., led the technical open forum discussion on defects in castings which were represented. New members were introduced and the meeting was closed by Vice-Chairman, Claude B. Schneible.—*R. Grant Whitehead.*

Central Indiana

William Ball, Jr., R. Lavin and Sons, spoke on "Effective Essentials to Make Good Castings," at the February meeting of the Central Indiana Chapter held at the Athenaeum, Indianapolis. Allen Evans, International Harvester Co., introduced the speaker.

Opening remarks by Mr. Ball covered the three M's, materials, machines and men. He pointed out that we no longer have the influx of trained or semi-skilled men of immigrant sources, thus, we have to create our own supply. Sand, he said, received a boost with the advent of the "C" process as the core oils, resins, molding machines, etc., all took second looks and attempted to duplicate "C" process results with the original tool, sand.

I. R. Wagner, charter member of the

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chapter and former AFS National President, pointed out that today, the AFS has made available research on the basic laws of which Mr. Ball spoke. This information, Mr. Wagner noted, is available to foundrymen through articles published in AMERICAN FOUNDRYMEN and also in the form of films, such as the "Fluid Flow of Metal."—*William H. Faust.*

Central Ohio

The February meeting of the Central Ohio Chapter was held at the Seneca Hotel, Columbus, Ohio.

Speaker for the evening was John F. Schnur, International Dept., Armour Research Foundation. His subject was "Directing Foundry Operations from Elephant Back in India." Mr. Schnur, who has spent the last two years working with the Indian foundrymen, discussed the foundry practices used in India today.—*Eldon Boner.*

Tri-State

Oklahoma City acted as host for the February meeting of the Tri-State Chapter held at the Biltmore Hotel. Roger Williams, Cities Service Oil Co., acting program chairman for the meeting, introduced the speaker of the evening, F. S. Brewster, vice-president and general manager, Harry W. Dietert Co., Detroit, who spoke on "Sand Control." Mr. Brewster's presentation was aided by a number of slides, and a discussion touching on rammibility, natural sands compared to synthetic sands, mold hardness, squeezer pressures, etc.

The 41 members and guests present entered into a discussion following the lecture. —*Edward O'Brien.*

Central Illinois

Members attending the February meeting of the Central Illinois Chapter were pleasantly surprised by their Chairman, Henry Helten, who introduced "his boss," L. E. Roby, Peoria Malleable Castings Co., as Technical Chairman for the evening.

Mr. Roby then introduced the speaker of the evening, Dean Van Order, Burnside Steel Foundry, Chicago, whose subject was "Time Study Methods." Mr. Van Order's explanation of the method of "work measurement" used at Burnside Steel for grinders and chippers proved to be unusual in it's application —*J. F. Kauzlarich.*

Western Michigan

Western Michigan Chapter met at Cottage Inn, Muskegon, Mich., for the February dinner and technical meeting under the direction of Fred J. DeHudy, chapter chairman.

Technical session was arranged by John A. Van Haver, vice-chairman, who presented the speaker for the evening, Harry H. Kessler, Sorbo-Mat Process Engineers, St. Louis. Mr. Kessler's subject was "Gating Practice."—*Wilson W. Hicks.*

Chesapeake

G. A. Riley, American Brake Shoe Co., New York, was guest speaker at the January meeting of the Chesapeake Chapter. His subject was "Safety." Mr. Riley pointed out that more effort should be made to prevent accidents rather than finding the cause of accidents after they occur. He made it clear that an accident is "Anything occurring in the plant that is unexpected, that has not been planned or that interferes with production," not only when an employee gets hurt.—*Henry M. Witmyer, Jr.*

Ontario

At the February meeting of the Ontario Chapter held in Toronto, two groups of men were honored. Special tables, appropriately decorated with crowns, were reserved for all men with 50 years or more in the foundry industry. The 25 men in this group were the "Kings for the Night." Collectively they represented more than 1,270 years of service.

The second group to be honored was that of Past Chairmen who were seated at the head table.

Norman Bennett, Canadian General Electric Co., introduced the technical speaker of the evening, C. B. Schureman, Baroid Sales Div., National Lead Co., Chicago. Mr. Schureman gave a revealing talk on "How About Becoming Sand Conscious." Speaking specifically on synthetic sands, he pointed out that with the proper application of base silica sand, and with proper application of bond and water, synthetic sands can be readily controlled to give the results desired.

Ernest H. Rubovitz, left, and Ray Olson, center, speakers at the Metropolitan Chapter panel discussion on shell molding. Right, Al C. Blanche, technical chairman. *Photo courtesy John Bing, Metropolitan Refractories Corp.*

The bonding material used will be governed by the type and size of castings being used, he said. Large heavy castings cannot be properly made using a bond with a low hot strength. Similarly light intricate work does not lend itself to using a bond with a high hot strength. A combination of bentonites and clays may be best suited for use in any shop, and must be worked out in each case.

Mr. Schureman scored heavily against the premise that any one sand can be made to do every, or all jobs in any foundry. He advocates the use of facing sands that will suit the job and render the finish required. "If you will become more sand conscious," he said, "you will not be plagued by problems that you will blame on the sand."

—*Wm. H. L. Bryce*

Central Michigan

Preceding the regular business meeting of the Central Michigan Chapter in February at the Hart Hotel, Battle Creek, Mich. A movie of the recent Tournament of Roses Parade at Pasadena, Cal. was shown as a "Coffee Talk."

Irving Dennen, Beardsley and Piper Div. Pettibone Mulliken Corp., presented a film, "Mechanization in Coremaking" which was followed by a discussion. Technical chairman for the evening was Albert Doerr, Midwest Foundry Co.—*Bob Dodge.*

Michigan State College

A joint meeting of Michigan State College Student Chapters AFS and A.S.M. was held in February at the College Union Building.

Thirty members of the two organizations were present to hear Vernon H. Patterson, Climax Molybdenum Co., Detroit, speak on alloys in cast iron. Mr. Patterson used slides to illustrate his remarks which covered the effect of all common alloys used in cast iron—*Thomas G. Thomas.*

Metropolitan

National Officers Night featured the February meeting of the Metropolitan Chapter held at the Essex House, Newark, N. J. The chapter was honored by

At the February meeting of the Philadelphia Chapter from left to right: Donald Bryden, chapter chairman; Chester V. Nass, Beardsley & Piper, Div. Pettibone Mulliken Corp., and National Director, guest speaker; Walter S. Giele, technical chairman for the evening, and Daniel E. Best, chapter vice-chairman.

Chapter News

the presence of AFS National Officers, President C. L. Carter and Secretary-Treasurer W. W. Maloney and Director-Elect H. L. Ullrich. President Carter addressed the chapter, outlining the aims and accomplishments of the National organization.

Walter A. Sokolosky, Monsanto Chemical Co., spoke on "Resins and Methods of Coating Sands." Ernest H. Rubovitz, Newark Pattern Works, spoke on "Pattern Equipment," including a discussion of materials and gating. Ray Olson, Production Pattern & Foundry Co., spoke on "Production Equipment" and showed slides illustrating various production methods.

Warner B. Bishop, Archer-Daniels-Midland Co., spoke on the "'D' Process of Shell Molding," illustrating his talk with slides showing some of the applications of this method. Technical Chairman was Al. C. Blanche, Worthington Corp.—*W. T. Bourke.*

Western New York

Western New York Chapter held its February meeting at Hotel Sheraton, Buffalo, N. Y. Guest speakers were Kenneth S. Cowlin, Grinding Wheel Div., Electro Refractories & Abrasives Corp., Buffalo, N. Y., and A. Lesley Gardner, Pangborn Corp., Hagerstown, Md.

Mr. Cowlin explained the difference and features of the various grinding wheels; resin, vitrified and rubber bonded. His talk included the code markings on abrasive wheels, bond, grain size, baking time, as well as various kinds of tests.

Mr. Gardner's talk covered the history, engineering, and maintenance of blasting. His presentation was illustrated with photographs and chalk sketches.

—*R. E. Walsh.*

Chicago Chapter

Over 600 Chicago chapter foundrymen and their ladies attended the annual ladies' night dinner dance at the Palmer House on Saturday evening, February 27.

Following a reception, an elaborate turkey dinner was served in the grand ballroom, with mood music by the orchestra. Dancing followed the dinner and the evening was climaxed by a full program of variety acts by TV and stage performers.

On Monday, March 1, the chapter held its regular monthly meeting at the Chicago Bar Association. More than 300 were present for the technical program.

During dinner, the foundrymen were entertained by the male chorus of Continental Foundry & Machine Co., under the direction of Dean Croxton.

Reports disclosed that the chapter had reached a membership of 793 and was closing in on the quota.

W. O. McFatridge, International Harvester Co., served as technical chairman.

F. S. Brewster, Harry W. Dietert Co., opened the meeting with a discussion of the D process of shell molding. This process, Brewster said, won't revolutionize the industry, but it definitely has a place. He used slides to illustrate the process, which consists briefly of blowing an oil-sand mixture between a pattern and a contour drier made of aluminum or iron.

One of the principal advantages of the process, he explained, was the use of standard foundry equipment. A production of 250 shells per hour was the goal. The shell can be made in any thickness or contour, a definite advantage. No shot, sand, or gravel backing is used since metal clamps are employed for the purpose.

Second speaker was T. E. Barlow, Eastern Clay Products Dept., International Minerals & Chemical Corp., who described the use of higher-than-normal molding pressures to achieve dimensional precision in castings. Referring to the process as "pressure" molding, he told how early work started in the 600 psi range and led to development of a technique suitable for pressures as low as 80 psi. Normal foundry pressures in molding are 10-60 psi, he said.

Pressure can be applied by means of a squeeze board or by a diaphragm, the latter requiring careful removal of tramp iron and other material that might damage the diaphragm. Aim of the process is to give high flowability to a green sand mixture, then squeeze it to the mold density required by the casting geometry and the desired dimensional accuracy. Mold hardness may be the same in two molds, but if one has lower density, it is liable to cause swells, he warned.

Attending the Western Michigan Chapter February meeting are left to right: Horace Deane, Harry H. Kessler, guest speaker, Fred J. DeHudy, chapter chairman and John A. Van Haver, chapter vice-chairman.

W. D. Dunn, left, Oberdorfer Foundries and president of the Central New York Past Chairmen's Club, presenting plaque to past chairman, Don J. Merwin, Oriskany Malleable Iron Co.

Obituaries

J. A. Bowers, 49, died February 13 from a heart attack. A native of Birmingham, Ala., he was superintendent of the melting department of American Cast Iron Pipe

J. A. Bowers

Co. Mr. Bowers presented several papers before AFS on refractories and on cupola operation. He was a member of AFS and the Engineers Club of Birmingham.

Leon M. Briston, eastern representative of E J. Woodison Co., died February 17, at his home in Syracuse, N. Y. He had been connected with Woodison for nine years.

Martin W. Henley, until his retirement in 1951, vice-president, Frazer & Jones Co., Syracuse N. Y., died recently. He was past president of the Syracuse Foundrymen's Association and a former National Director of AFS.

Cortner M. Hardy, 65, died recently. He was senior partner of Hardy Sand Co., Evansville, Ind. Mr. Hardy pioneered in production of controlled foundry sands and at the time of his death was president of the National Industrial Sand Association.

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Foundry Tradenews

The office of Defense Mobilization has issued certificates of necessity for accelerated tax amortization because of expanded facilities to **Reliance Steel Castings Co., Pittsburgh, Pa.;** and **Warren Foundry & Pipe Corp.,** Phillipsburg, N. J. Reliance was permitted to depreciate 35 per cent of $87,201 at the accelerated rate; Warren was authorized 65 per cent of $528,523.

U. S. Reduction Co., East Chicago, Ind., is observing its 50th year of operation during 1954 and claims to be the oldest independent aluminum smelter in the country. The company produces aluminum alloys for die casting, sand, permanent molds, and plaster. Deoxidizing and alloying aluminum is produced for steel foundries. USCO Plate Corp., a wholly owned subsidiary, makes cast aluminum plate in varying thicknesses, zinc diecasting alloys, slush metal, and aluminum-copper hardness.

Denver Equipment Co. has opened a new office in Salt Lake City, Utah. J. G. Uzelac, for several years manager of Deco's Chicago office, will head the new branch, which will service Utah and the northwestern states. Keith Wick, former sales engineer in the company's Denver office, has taken over the Chicago territory.

The Detroit office of **Lindberg Engineering Co.** has moved into new, modern offices in suburban Royal Oak, Mich. Frank J. Condit manages this Lindberg branch.

Sterling Abrasives Division, Cleveland Quarries Co., Tiffin, Ohio, has opened a new warehouse and sales office in Philadelphia. A full stock of the firm's grinding wheels and related abrasive items will be carried at all times.

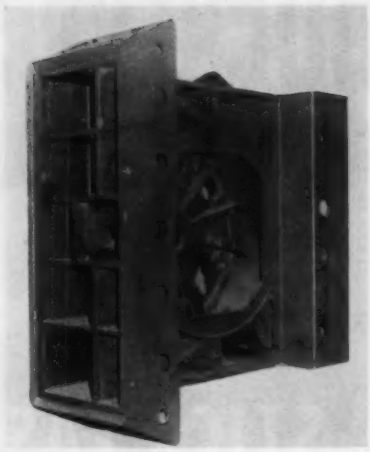
Mars Engineering, Inc., Newark, N. J., has added a new division, which will design industrial dust collection and fume elimination systems. The firm has heretofore specialized exclusively in the design and manufacture of machinery.

Bartlett and Snow, Cleveland manufacturers of car type mold conveyors, have licensed **Coleman-Wallwork Co., Ltd.,** an English company, to produce and sell their product in sterling areas, Asia, and Africa.

Entire stock of **Sutter Prods. Co.,** Detroit, has been purchased by Ray H. Sutter, president. Percy L. Sutter, vice-president, has retired, effective January 1. Expanding company operations have necessitated further personnel changes (see *Foundrymen in the News*).

Salem-Brosius, Inc., Pittsburgh, Pa., has announced the purchase of the **George J. Hagen Co.** Both companies design, manufacture, and sell furnaces and heat treating equipment. The acquisition will give Salem-Brosius increased diversification in fields they have not entered before. W. A. Wickwire, Jr., becomes president of both companies.

Detroit branch of Lindberg Engineering Co. recently occupied this modern office building in nearby suburban area.



Ordered by Western Electric as a base for military electronic equipment, largest magnesium casting ever poured is claimed by Rolle Mfg. Co., Lansdale, Pa. Weighing approximately 1630 lb, the 114 x 93 x 33-in. casting would weigh more than five times that amount if cast in steel. The 197 cores used were contained in a foundry flask measuring 128 x 112 x 48 in.

Eaton Manufacturing Co. will build a research center in Cleveland intended primarily for development of new products for auto and aircraft industries. Suburban Bratenahl is the site for the $1.5 million project.

Link-Belt Co., Chicago, has published a 40-page, profusely illustrated booklet on foundry mechanization. The comprehensive publication describes sand preparation units, and mold, core, casting and sand handling equipment. Over 70 pictures of actual installations and perspective drawings of foundry layouts are included.

The 1953 annual review of engineering developments in its many fields has just been released by **Allis-Chalmers Manufacturing Co.,** Milwaukee. The 36 illustrated pages briefly cover the year's developments at A-C.

Second Metals Handbook Volume Now Off Press

The second volume of the A.S.M.E. handbook, *Metals Properties,* was published by McGraw-Hill in March. The book contains valuable tabulated engineering data on metallurgical, physical, fabrication, and mechanical properties of typical metals and alloys. Data are provided on more than 500 metals in common industrial use.

The volume is the second in a series of four, first of which was published in October, 1953. Remaining two will be ready during 1954.

The new book will sell at retail for $11. Further details are available from McGraw-Hill Book Information Service, 327 W. 41st St., New York 36. A postcard will bring complete information.

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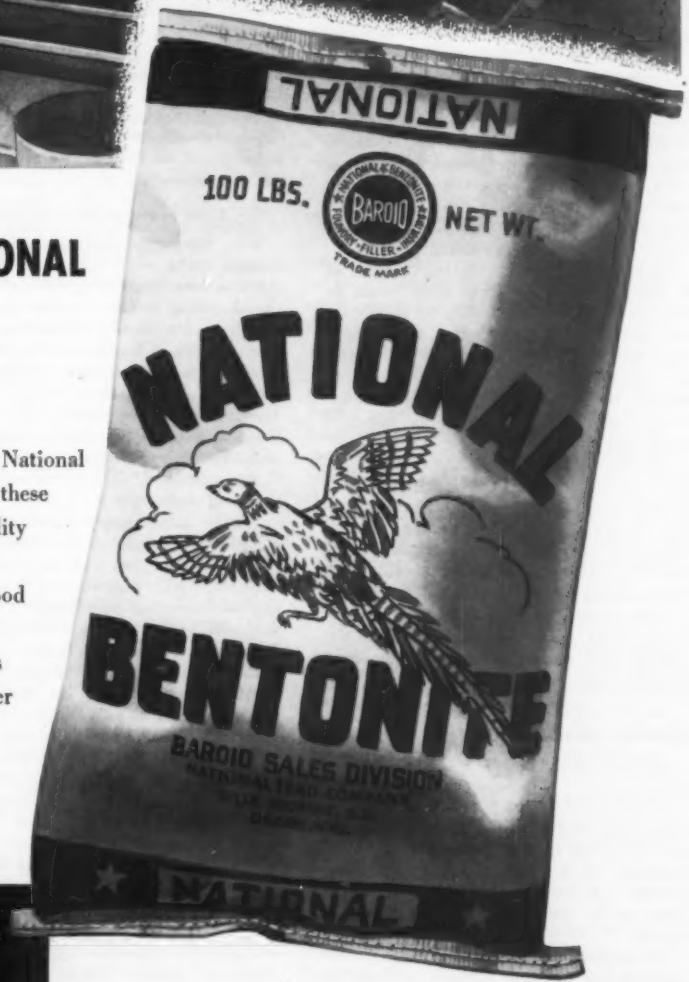

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A. B. Sinnett . . . joins AFS staff

AFS Appoints New Educational Director

AFS national office has announced the appointment of Ashley B. Sinnett as Educational Director of the Society.

Working from the Chicago headquarters, Sinnett's operation will consist primarily of liaison activities to broaden interest in foundry at the high school-technical-vocational-trade school level. In this work he will cooperate extensively with local AFS chapters in the promotion of their educational activities, and function in all areas in which the national Society operates education-wise.

Sinnett graduated from high school at Lufkin, Texas and, after three years in the Navy, received his B.A. in industrial arts and vocational education from Michigan State College, 1952, with a minor in mechanical engineering, consisting mostly of foundry and physical metallurgy. He will complete his master's work this summer.

He has spent two years since graduation on the staff of the mechanical engineering school at Michigan State, teaching foundry, patternmaking, and manufacturing processes. In addition to his teaching, he has worked in several foundries during vacation periods.

Sinnett will join the AFS staff formally on April 1. He will participate in the educational activities at the Cleveland Convention.

Government Publishes New Steel Casting Pamphlet

A new publication just released by the U.S. Department of Commerce describes an improved master pattern and better methods of pouring the bismuth mold halves and joining the expandable wax patterns for investment casting of carbon steels.

Other data include proper methods for melting out the wax pattern, baking the investment mold, pouring the casting, shrinking out the mold, and final sandblasting.

Order from Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. Refer to PB 111199, Investment Casting of SAE 1040 Steel. Send 50 cents.

Wis. Regional

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workers using the oldest molding method known to man—bedding the pattern in the floor and using a cope flask only. In cases where a drag was used, no bottom board was employed, he said, hard ramming being relied on. Molders are unused to conventional shovels, rammers, and molder's tools, he reported.

Cores of any size are swept, Mr. Schnur stated, and they are baked with open fires. Usual binders are considered too expensive and cow dung is therefore used. Indian attempts to save money by means of cheap pattern construction usually results in their losing money on the molding floor, he declared.

Melting ratios run about three to one, Mr. Schnur indicated; coke contains as high as 30 per cent ash. Only sources of pig iron are two steel mills which sell foundries their off grades. Indian foundries can boost their production about four fold, he concluded, with very little additional investment.

Four sets of five simultaneous technical sessions were held, covering steel, gray iron, malleable, non-ferrous, and pattern subjects.

Steel Features Four Speakers

The steel meetings featured the following talks and speakers: *"Practical Applications of Recent Information to the Feeding of Steel Castings,"* B. C. Yearley, National Malleable & Steel Castings Co., Cleveland; *"Modernization of the Foundry,"* Glenn W. Merrefield, Giffels & Vallet, Inc., Detroit; *"Housekeeping in the Foundry,"* C. G. Lauckner, General Electric Co., Schenectady, N. Y.; and *"Casting Quality as Related to pH Value of Sand,"* G. J. Grott, Unitcast Corp., Toledo, Ohio.

While foundrymen are justified in criticizing designers for some of the casting shapes they call for, the foundryman should give more attention to feeding and risering problems, Mr. Yearley said. He reviewed the work done at the Naval Research Laboratory which included a discussion of risering flat plates. NRL investigations, he stated, show that a plate will be solid for 2½T from the cold end and 2T from the riser end (T equals thickness). In a plate risered at both ends, the casting is solid 2T from each end. With a chill in the center, the casting will be solid for a distance of 9T.

Re-entrant angles dissipate heat much more slowly, Mr. Yearley reported, therefore an L-section requires 1½ times as long to solidify as a flat plat and a T-section 1½ times as long. The speaker discussed other NRL formulas and showed by illustration that they applied in the shop. E. Tetzlaff, Pelton Steel Castings Co., was chairman and David C. Zuege, Sivyer Steel Casting Co., was co-chairman of the meeting.

Foundry modernization plans should be made in two steps according to Mr. Merrefield—study of present facilities and layout of a projected program. Advantages of mechanization must be weighed against equipment cost, he said. Proper ventilation and fume control are essential in a modern foundry, along with adequate shower and locker rooms and clean lunch rooms. Concentration of pouring operations in one area makes fume removal simpler, he said, adding that the same is true of shake-out.

Trend is toward larger flasks with multiple patterns in the mold, Mr. Merrefield indicated. Pouring monorails should include spurs to take ladles to the repair zone. Gantry cranes are much more effective for small areas than multiple overhead cranes, he said. More and more jobs are going into cores and the core room should be laid out with a view to expansion. Cleaning room capacity should exceed melting capacity because this department must not only clean but also salvage castings, he declared. Co-chairmen of the meeting were Anthony Herrmann, Belle City Malleable Iron Co., and John K. McBroom, Stainless Foundry & Engineering Co.

Anyone who knows the fundamentals of good housekeeping can clean up a foundry, Mr. Lauckner said in criticizing foundrymen for not applying this knowledge more extensively. Good housekeeping is important, he pointed out, because it affects the appearance of the shop which in turn affects morale and attitude of employees. A foundry not in the upper 25 per cent from the standpoint of appearance and good housekeeping probably is not making as large a net profit as it should be making, he declared. Erich M. Sobota, Wisconsin Electric Power Co., and D. S. Bosma, Bucyrus-Erie Co., were co-chairmen.

Add Soda Ash To Control pH

At the final steel session, Mr. Grott reviewed his company's experiences with control of sand mixtures in an optimum range of pH by means of soda ash additions. Results gave a high degree of freedom from scabs due to sand, he said. (Entire article appears in AMERICAN FOUNDRYMAN, March 1954, pp. 49-59.)

First of four gray iron speakers was W. A. Sokolosky, Monsanto Chemical Co., St. Louis, who brought his listeners up to date on uses of synthetic resins in the foundry. In discussing mixtures for shell molding, he described use of wetting agents or methanol with cold sand, and lump or liquid resin with hot sand. Though coated sands reduce resin required for equivalent shell strength, he said, heat transfer increases with decreased resin content. As a result, it is more difficult to hold casting dimensions with coated sands than with conventional sand-powder resin mixes.

Good metallurgical and foundry practice are just as essential in shell molding as in green sand, but are easier and more positively controlled, Mr. Sokolosky said. He listed as advantages of pouring shell molds horizontally: heavier castings can be poured without back up; higher yield; less gas trouble; cleaner castings; easier handling prior to pouring and in shake-

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Convention

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cores and green sand molding to production of smooth, precise gray iron castings. Grain size and distribution of "fine" sands are the chief considerations in achieving smooth casting surfaces. One of the factors in holding close tolerances (2 to 3 thousands in. per in. in green sand) was keeping deformation in the low 20's.

54-18 . . "Establishing Standards for As-Cast Surfaces," Roy A. Loder, Erie Malleable Iron Co. Eight grades of sand paper were used as patterns for green sand casting of aluminum alloy surface comparison standards. (See pp. 44-45 this issue.)

54-30 . . "Pre-mixing of Reconditioning Materials for Molding Sand," Burdette Jones, John Deere Tractor Works. Premixing of sand additives has resulted in saving of materials, better control of sand properties, and a cleaner sand conditioning department. (Will appear in May issue.)

54-34 . . "Selection and Mulling of Synthetic Sands," C. E. Wenninger, National Engineering Co., A refractory-industry concept of dynamic orderly packing of particles is applied to sand grains during mulling. Author concludes that base sands must possess grain shapes and distributions compatible with promotion of orderly packing during mulling—the better a sand satisfies these requirements, the more rapid will be its response to mulling. In addition, he concludes that a mixture of base sand, bonds, and moisture must be mulled until it is composed predominantly of orderly formations or colonies. The more thorough the mulling, the greater the degree to which orderly formations will be established within a mixture. Presence of numerous formations will be reflected by the superior physical characteristics conferred upon properly rammed cores and molds.

54-44 . . "Pressure Molding with Standard Synthetic Sand," T. E. Barlow and W. R. Adams, Eastern Clay Products Dept., International Minerals & Chemical Corp. Study was made to determine to what extent regular synthetic sand might be adaptable to precision, high-pressure molding. Precision may be obtained by improving sand flowability, or by increasing mold squeeze pressure, or by special molding equipment such as needed for diaphragm or contour molding. Degree of precision depends on pattern equipment of the extent to which one or more of the three variables above are utilized.

54-45 . . "Research on Shell Molding," R. G. Powell, C. M. Adams, Jr., and H. F. Taylor, Massachusetts Institute of Technology. Factors influencing resin consumption in making shell molds were studied by means of strength tests. Experiments were made with surface preparation of sand to increase bonding efficiency, and with vibration to improve packing. Polished sections of shell specimens were used to study the mechanisms of bonding and fracturing of shells. A theory of hydrogen bonding is postulated to explain bonding mechanism between resin and sand.

54-53 . . "Zircon Sands—Occurrence and Uses in Australian Industry," Paul Markwell, McLean Castings Ltd. Mineralogy, occurrence, and commercial deposits of zircon sand in Australia are briefed and properties such as refractoriness, conductivity, density, expansion, and resistance to wetting by molten metal are discussed. Typical mixtures for green sand, cores, mold and core washes, and parting dust are given.

54-56 . . "Statistical Analysis of Factors Affecting Casting Finish," D. C. Ekey and J. E. Goldress, Pennsylvania State University. Alumium alloy test castings were poured in green sand molds under controlled conditions to determine the magnitude of the influence of sand fineness, metal pressure, and wood floor on surface finish. A dial indicator with adapter was used to measure roughness. Sand fineness and metal pressure have a significant effect on finish whereas wood floor does not. Work in intended to be exploratory and further work is required to develop values for specific effects of the variables studied.

54-59 . . "Another Look at Sand Grain Distribution," B. H. Booth, Carpenter Bros., Inc., and C. A. Sanders, American Colloid Co. Terms like 1-screen, 3-screen, etc., are used frequently to indicate grain distribution. What percentage of the specimen has to remain on a screen to qualify it as a "screen" under the above terminology is an unsettled question. The authors believe that the "number of screens" designation is not sufficiently definitive to deserve precise definition but feel it is useful for rough description.

54-60 . . "Casting Quality as Related to pH Value of Molding Sands," V. E. Zang and Gerald J. Grott, Unitcast Corp. Influence of soda ash and weak acids on pH, and this in turn on the mechanical properties of molding sand mixtures bonded with bentonite, bentonite plus cereal, and fireclay as well as on a system sand was measured. Numerous test castings show how the authors decided on best pH range to achieve freedom from scabbing. (AMERICAN FOUNDRYMAN, March 1954, pp. 49-59.)

54-65 . . "Core Blowing Problems," John A. Mescher, Unitcast Corp. Trouble-shooting tips for the coreroom making blown cores. First look for soft spots; check to see that blow holes lead sand by direct paths to as much of the box as possible; no harm comes from over-venting a box, but under-venting always causes soft cores. Allow a period at the end of each shift for cleaning vents and boxes. Minimize wear at the box parting, bottom, and sand entrance holes using seven suggestions listed. Reduce set-up time with single blow hole machines for small boxes, and with universal blow plates for larger boxes. Increase production by putting a man on either side of a machine, each with an identical box so one can draw a core while the other is blowing.

54-69 . . "Metal Penetration Tests on Dry Sand Cores and Core Washes," Mold Surface Committee of AFS Sand Division. A graphite-base and a silica flour-base wash previously described in the literature were prepared and tested by the penetration test developed by Gertsman and Murton. Results, which committee points out apply only to the washes tested and strictly under the conditions of the particular tests carried out, indicate that the silica wash performed somewhat better than the graphite wash.

54-75 . . "Recent Developments in Shell Molding," E. I. Valyi, A.R.D. Corp. Future of shell molding was changed by a large price reduction in phenolic binders in 1953. Procedures for producing non-segregating sand-binder mixes have been developed. Improvements in pattern coating and pattern heating are major contributions of the equipment industry. (Will appear in May issue.)

54-77 . . "Olivine-Silica Molding Sands," Gilbert S. Schaller and William A. Snyder, University of Washington. Olivine and silica were combined in three ways as facing materials with a silica, system-sand backing to test use of such combinations in steel foundry work. Authors conclude that olivine flour can be used successfully for controlling properties of silica-base synthetic sand even though fusion point is reduced (not seriously up to 20 per cent olivine). They predict that cleaning cost of large castings would be reduced through use of olivine flour. In some cases, but not consistently, sands containing olivine scabbed less than those containing silica flour. Sands with olivine flour were less sensitive to moisture variations.

54-88 . . "What Is Stickiness in Core Sand Mixtures?" Wayne H. Buell, Aristo Corp. Progress report of Sub-Committee on Core Stickiness, Core Test Committee, AFS Sand Division, describes complexity of problem in which a good sand binder is expected to be a good adhesive, yet not stick to the core box. Published methods of evaluating stickiness, such as the retained sand and the parting force methods, were used to test various sand mixtures.

Steel

54-41 . . "Design and Operation of a Modern Heat Treating Department," Richard W. Wilson, American Hoist & Derrick Co. Furnaces, quenching systems, and material handling equipment must be selected on basis of heat treating operations required and possible future expansion. Story shows how new casting heat treating department at author's company was planned and set up. (Will appear in May issue.)

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Wis. Regional

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out; less metal turbulence making horizontal pouring especially suitable for aluminum.

R. M. Stair, General Malleable Corp., and F. Kulka, Motor Castings Co., were session co-chairmen.

"Effect of Some Variables in Cupola Operation" was the subject of Sam Carter, American Cast Iron Pipe Co., Birmingham, Ala., at the second gray iron session. Key considerations in cupola operation are sulphur absorption, carbon pickup, and oxidation loss of silicon. Coke composition and size influence all three, he said. Sulphur increase is directly proportional to sulphur in coke. Carbon pickup is higher with pitch coke, lower with a high-ash coke, and is lower the higher the sulphur content of the iron.

Mr. Carter advised eliminating coke fines, presence of which increase silicon and mangenese loss and generally increase operating difficulties. High metal to coke ratio leads to low temperatures while low ratios increase carbon and sulphur pickup. He outlined his company's six years of experience with basic cupolas, pointing out that such melting units are ideal for production of nodular iron. H. W. Schwengel, Modern Equipment Co., and T. H. Tanner, Zenith Foundry Co., were co-chairmen of the meeting.

Theodor Redin, Wm. Demmler & Bros., Kewanee, Ill., briefed the history of coreblowing, bringing his listeners up to date with a discussion of equipment for blowing D-process shells and for blow-squeeze production of green sand molds. E. C. Wussow, Kaukauna Machine Corp., presided at this third gray iron session.

Latest Core Blower Design

Mr. Redin indicated that latest designs in core blowers include automatic and semi-automatic machines with long draw strokes, sand magazines with slotted sleeve or motor driven agitator, automatic squeeze mechanisms, and shuttle devices which automatically bring the core box from the roll-over machine into the core blower and return it to the roll over after blowing.

A stack molding operation in which mold sections are blown, then squeezed, and ejected from the machine in an 8.2 second cycle beginning when the operator pushes the starting button was described by Mr. Redin. While the potential of such equipment is 2000 flasks in eight hours, the operation is confined to 750 in eight hours at present. Mold sections have sand to sand contact instead of flask contact to eliminate runouts. The speaker concluded with a general discussion of conventional core blowing and rigging.

In joint presentation T. W. Curry and Carl B. Stone, Lynchburg Foundry Co., Lynchburg, Va., described practical application of fluid flow principles to gating. They gave a number of formulas in use in their plant and listed as basic requirements of a good gating system: tapered and choked sprue; metal flow of 12 in. per second; optimum pouring time, which must be determined for each casting; smooth turns in runners; reduction of runner size as ingates are passed.

Advantages of good gating, Messrs. Curry and Stone indicated, include reduction in scrap, improved quality control, lower cleaning costs, and better appearance and yield. Co-chairmen of the meeting were L. J. Woehlke, Grede Foundries, Inc., and E. Zick, J. E. Gilson Co.

Work simplification and mechanized shell molding were described and illustrated by means of motion pictures at the first malleable session. James H. Smith, Central Foundry Div., General Motors Corp., Saginaw, Mich., was speaker. Co-chairmen were N. Amhrein, Federal Malleable Co., and D. E. Feather, Appleton Electric Co.

Using excerpts from his Hoyt Annual Lecture (AMERICAN FOUNDRYMAN, June 1953, pp. 42-47), Mr. Smith told of his company's shell molding installation in which one operator controls two automatic molding machines and two units for assembling and cementing shell halves with powdered resin binder. Molds were poured horizontally on a pendant conveyor.

Program Reduces Cost

Use of tools and materials to better advantage in the GM work simplification program, Mr. Smith pointed out, makes jobs easier, eliminates wasted energy, and improves working conditions. Advantages of the program outlined, he said, include improved quality, reduced costs, relief of monotony and fatigue, and more satisfied and efficient employees.

At the following malleable session, W. D. McMillan, International Harvester Co., Chicago, discussed three undesirable surface conditions on malleable castings, and Adam Kafka, Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago, presented a film on mechanized core making. Stephen Pohl, Federal Malleable Co., and Mr. Feather were co-chairmen.

Casting surface is important, Mr. McMillan said, because it is most highly stressed in service. He attributed graphite skin (high carbon, weak) to slow cooling, and to loss of carbon due to incorrect CO-CO_2 ratio during annealing. Pearlite rim (machines hard, has high tensile strength and low elongation, may crack in straightening) can be due to oxidation or to excess manganese, he stated. Ferrite skin gives a low yield point and tensile strength, high elongation, bends easily, and is not good for threading.

Mr. Kafka said core blowers can produce at least three times as fast as a man working by hand. Jobbing foundries need not go into elaborate core boxes for blowing or production of cores by slinging, he declared The film showed a range of operations from simple, open boxes to six-station, fully automatic core making, as well as the use of slingers.

At a third malleable session, Prof. R. W. Heine, University of Wisconsin, highlighted the effects of melting furnace atmospheres on the mechanical properties of malleable iron. M. A. Harder, Lakeside Malleable Casting Co., and N. Amhrein, Federal Malleable Co., co-chairmanned the session.

Conclusions Drawn

Among conclusions developed by Prof. Heine were: no silicon loss will occur at elevated temperatures unless free oxygen exists in the furnace gases or FeO is introduced from some source; net changes in silicon are the best measure of severity of oxidizing or reducing conditions: a carbon range of minimum hot tear resistance exists; and melting furnace gases can have a greater effect on nucleation of graphite, nodule count, and carbide stability than does carbon percentage in the iron or temperature of the iron during the high temperature stage of melting.

R. A. Witschey, A. P. Green Firebrick Co., Chicago, described production of firebrick with the aid of a motion picture, and told how to use plastic linings in electric furnaces at the concluding malleable meeting. Co-chairmen were Messrs. Feather and Pohl.

Hiram Brown, Solar Aircraft Co., Des Moines, Iowa, led off the non-ferrous sessions with a general discussion of light metal foundry practice. K. L. Jacobs, Standard Brass Foundry Co., and E. W. Jagmin, Ampco Metal, Inc., were co-chairmen of the meeting.

Every foundry larger than an "alley shop" should have a laboratory and a metallurgist to help evaluate shop practices and to suggest techniques for improving quality and reducing scrap, Mr. Brown stated. He discussed selection of furnaces, use of pots and crucibles, and melting. Small variations in chemical analysis will affect casting properties before they will affect normal laboratory tests, he pointed out, advising that scrap of unknown composition should be refined and poured into ingots for analysis before use in castings.

So-called high pressure molding was discussed by T. E. Barlow, Eastern Clay Products Dept., International Minerals & Chemical Corp., Chicago, at a session which had as co-chairmen Henry Seeboth, Thomas H. Gregg Co., and Lloyd Quirk, Carpenter Bros., Inc. Trend in high pressure molding, according to Mr. Barlow is away from the original 500-600 psi originally used and work is currently being done at around 100 psi. Technique of pressure molding, the speaker indicated, is to give the sand a high flowability by means of special additives, then squeeze it to the desired density as called for by casting geometry and dimensional tolerance requirements. Aim in pressure molding is to achieve same dimensional accuracy given by the C- and D-processes, he declared.

H. M. St. John, Crane Co., Chicago, reviewed general principles of brass and bronze practice at the third non-ferrous

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52 ND YEAR OF CERAMIC LEADERSHIP

Convention

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54-57 . . "Pouring Temperature Effect on Steel Castings," C. F. Christopher, Continental Foundry & Machine Co. Temperature relationship between the freezing casting surface and the molten core of the casting determines susceptibility to porosity. (See pp. 51-55.)

54-58 . . "Why Did It Fail?" M. V. Herasimchuk, Bethlehem Steel Co. To help study of repetitive equipment failures, the paper presents a simple procedure for classifying failures as design problems or metallurgical problems. First step is to take two or more cases of failure and measure the distance from the origin of the failure to some fixed point. If the distances are the same, suspect a design problem; if variable, suspect a metallurgical fault. Application of these tips is illustrated by studies of breakage in pneumatic chisels.

Safety & Hygiene & Air Pollution

54-82 . . "Cupola Fly-Ash Suppression," R. M. Ovestrud, Minneapolis-Moline Co. Story on 2½ years operating experience with a water curtain cupola dust collecting system. System consists of one collector head for each of two 66-in. cupolas, a 3000-gallon recirculative dewatering tank, and two 20-hp, 250-gpm sludge pumps. Author concludes that, although purchase of the system was justified primarily on the basis of reduction in roof maintenance and fire hazard, overall plant housekeeping has been markedly simplified too. Calls from the smoke inspector and irate housewives on washday have ceased, and foundry is not only a better place in which to work but is a better neighbor in the community.

54-85 . . "Protective Equipment," Ray L. Berger, Belle City Malleable Iron Co. Experience in author's plant and others studied shows definite relationship between foot accident frequency and coverage of employees with safety shoes; also that there was greater coverage the greater the company contribution toward shoe cost. His company's prescription safety glasses program has reduced scrap on the molding lines and has reduced eye cases from 40 per cent to 6 per cent of the annual doctor cases in three years.

54-86 . . "Training in Accident Prevention," T. A. Kraklow, Deere & Co. Accident prevention and production go hand in hand—if workers do their jobs as they should be done, the problem of accident prevention would be solved. The supervisor is the key figure in safety training and continued emphasis on safe practices. Three important steps for the supervisor are: (1) Teaching safe work habits, maintaining interest in safety among workers, and discussing safety problems with them singly and in groups; (2) Keeping his department free from accident hazards by his examples; (3) Investigating accidents to workers and equipment to learn causes and to use this to prevent other accidents.

54-87 . . "Foundry Hygiene Problems, H. J. Weber, American Brake Shoe Co. Discussion of common, potential health hazards designed to make foundrymen aware of materials that may create hazards, though they may create only a nuisance or cause no trouble whatsoever. Good practice calls for the following as minimum medical protection of workers: (1) Pre-placement physical examination and chest x-ray; (2) Annual physical examination and chest x-rays; (3) Adequate first aid facilities in case of injury or illness. Characteristics of following materials that may be encountered in foundry practice are given: acrolein, beryllium, chromium, fluorides, iron oxide, lead, noise, resins, sea coal, silica, and many others.

Malleable

54-14 . . "Effect of Prebaking in Malleablizing Iron," Floyd Brown, North Carolina State College. If white cast iron is held isothermally at some subcritical temperature or is heated slowly through the subcritical range, many more graphite nodules develop during subsequent first stage malleabilizing than develop if the white iron is heated rapidly to the first stage temperature without an isothermal pretreatment. Work reported shows that such prebaking leads to formation of graphite nuclei, does not require hydrogen which in fact inhibits the effect, and that effect was greatest at about 400 C for the irons studied. (AMERICAN FOUNDRYMAN, February 1954, pp. 50-51.)

54-48 . . "Strength of White Irons in the Temperature Range of Hot Tears," J. P. Franck and R. W. Heine, University of Wisconsin. Commercial white iron tensile bars were heated while under tensile load to show that strength varies from nothing to several hundred pounds at temperatures of 2030-2200 F. Strengths under these conditions are of the same order of magnitude as the hot compressive strength of molding and core sand. Contraction of a few thousandths of an inch can cause complete tearing. (AMER-

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Now, There's an Idea!

Practical ideas, developed and proved in foundries and pattern shops, are presented in this column. "Now, There's an Idea!" helps *American Foundryman* readers promote the exchange of ideas, the motivating force behind the AFS Contributions for publication are solicited. They may be of any length, preferably short, illustrated by photo or sketch.

■ Holding close dimensional tolerances on this green-sand casting posed a problem until Edward R. Lund, foundry superintendent at the Allis-Chalmers La Crosse (Wis.) Works, added small fins (see arrows) to maintain concentricity and flatness during solidification. The fins are readily knocked out during cleaning. Checked by the gauges in the foreground, the castings must meet the following requirements: concentricity, ± 0.015 in.; height, 5/4 ± 0.015 in.; center diameter, ± 0.015 in. Casting weight is 2.188 lb, section thickness 1/16 to 5/16 in.

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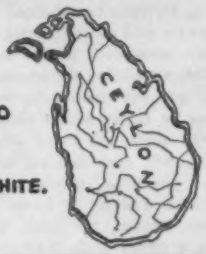

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Wis. Regional

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session. Carl Van Buren, Milward Alloys, Inc., and Otto Sadofsky, Kenosha Brass & Aluminum Foundry Co., were co-chairmen.

Improved methods and labor-saving equipment must be adopted by foundrymen in order to compete with other methods of production, according to Mr. St. John. Pyrometric control of pouring temperature and close control of molding sand are essential practices, he said. Push button molding shows great promise but has not yet been adapted to small foundries or those which handle a great variety of work. He cited shell molding and dielectric core baking as advanced foundry practices meriting study by foundrymen wishing to keep up to date.

Messrs. Brown, St. John, and Barlow acted as a panel with Walter W. Edens, Allis-Chalmers Mfg. Co., as moderator to answer a variety of questions on nonferrous practice including heat treatment of castings, adverse effect of humidity in melting, and the difference between erosion and expansion scabs. Co-chairmen were Otto Sadofsky, Kenosha Brass & Aluminum Foundry Co., and Lloyd Quirk, Carpenter Bros.

"Casting and Related Pattern Design" was the subject of the first talk sponsored by the pattern group. Speaker was William P. Bender, General Electric Co., Erie, Pa. Walter Kollmorgen, Kollmorgen Pattern Works, and M. C. Frankard, Delta Div., Rockwell Mfg. Co. were co-chairmen of the session.

Planned engineering of castings and patterns is one of the keys to higher quality at lower cost, Mr. Bender said. He described his company's program for handling quotations by means of a committee of molding, core, and cleaning room foremen, as well as a cost and wage rate supervisor, headed by a designer. The group goes into detail on all phases of production and tooling. The designer, Bender pointed out, must be grounded in foundry and pattern practice, must be familiar with machine shop practice, and must know something of the practical use of the castings in the unit being manufactured.

George K. Dreher, Waukesha Foundry Co., looked into the future and predicted what foundries and pattern shops might expect in 1975. H. Arneson, Spring City Pattern Works, Inc., and W. T. Schmidt, Giddings & Lewis Machine Tool Co., were co-chairmen of the session. Mr. Dreher said castings production would be up one-third over 1949, amounting to 24 million tons a year. Increased accuracy in pattern equipment would be necessary and better information on shrinkage and materials would be necessary. He called for an improved apprentice training program and suggested that in looking for apprentices, management should talk to school instructors.

Walter Siebert, Cleveland Standard Pattern Works, Inc., Cleveland, gave practical tips on construction of wood patterns at the third pattern session. M. C. Ehrman, International Harvester Co., and C. A. Baumgardt, Fond du Lac Pattern Works, were session co-chairmen. Among his recommendations were: consult the foundryman who is to make the casting; don't skimp on lumber thickness; avoid loose pieces where possible; make core prints sufficiently large to carry weight of core and permit solid anchorage.

Other suggestions were: use as much draft as design will permit; always start a core box as a sturdy rectangular frame; make sure the outer shell of the box is well battened; and always make pattern equipment in such a way that the foundry cannot make errors in setting up the job.

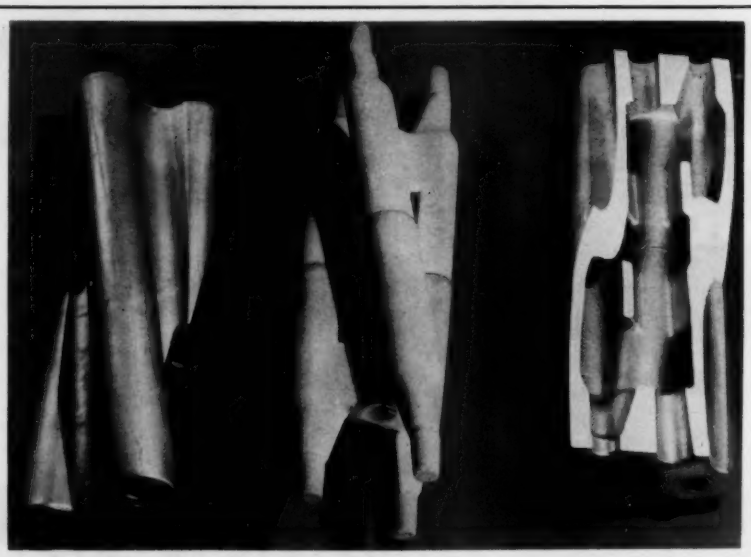
Shell Mold Patterns

Ray Olson, Shell Process Inc., Chicopee, Mass., discussed patterns for shell molding at the final pattern session. H. Wesley Stokes, Waukesha Foundry Co., was chairman, with Steve Denkinger, Jr., Atlas Plastic & Aluminum Pressure Plate Co., as co-chairman. Shell molding patterns are no different from conventional patterns, the speaker said, except that they are used at temperatures of 400-500 F. He recommended cast iron or steel patterns and plates, pointing out that brass, though satisfactory in other respects, is not sufficiently resistant to nicking.

Aluminum patterns must be completely free of pin-point porosity, particularly on vertical surfaces, he said, adding that aluminum can be used for up to 15,000 shells if protected from nicking. Mr. Olson said there should be no more concern about making a shell mold pattern than there is over patterns for the conventional foundry processes.

Conference committee chairmen, in addition to those previously named, include: Tickets—E. C. Meagher, Federal Foundry Supply Co.; Gray Iron—H. W. Schwengel, Modern Equipment Co., and T. H. Tanner, Zenith Foundry Co.; Malleable—F. E. Katzenski, International Harvester Co., and Stephen Pohl, Federal Malleable Co.; Steel—John K. McBroom, Stainless Steel Foundry & Engineering Co., and D. S. Bosma, Bucyrus-Erie Co.; Non-Ferrous—Carl Van Buren, Milward Alloys, Inc., and O. Sadofsky, Kenosha Brass & Aluminum Co.; H. Wesley Stokes, Waukesha Foundry Co., and H. Arneson, Spring City Pattern Works.

Treasurer—L. J. Gratz, G. & O. Pattern Works; Ticket Sales—Erich M. Sobota, Wisconsin Electric Power Co., and M. R. Kotvis, Foundries Supply & Sales Co.; Arrangements—H. O. Boehm, Allis-Chalmers Mfg. Co., F. M. Jacobs, Standard Brass Works, M. A. Harder, Lakeside Malleable Casting Co., and C. J. Risney, Risney Foundry Equipment Co.; and Publicity—D. M. Gerlinger, Walter Gerlinger Inc. Reporters were Messrs. Stokes, Jagmin, Quirk, Tanner, Zuege, McBroom, and Paul J. Mikelonis, Grede Foundries, Inc., John McIlhone and Carl H. Litt, International Harvester Co., and John Penner, Interstate Supply & Equipment Co.



Here's How the Maco Corp., Huntington, Ind., cut production cost of aluminum castings and time required in machining by using Bakelite phenolic resins as a sand binder to provide the permanence of form needed to prevent distortion of the precisely molded cores when removed from the core box and assembled. Cores produced by this method are baked in the core box to the desired strength and rigidity in a few minutes, it is claimed. This eliminates the expense of a large number of absolutely accurate core driers, required to produce conventional cores. These cores must also withstand the pressure and heat of molten aluminum at 1425 F long enough to shape accurately the interior of the casting. Since the finished casting must be balanced, the more accurate cores save machining of the interior after all outside surfaces have been finished. *Bakelite Co.*

For more data, circle No. 206 on p. 17

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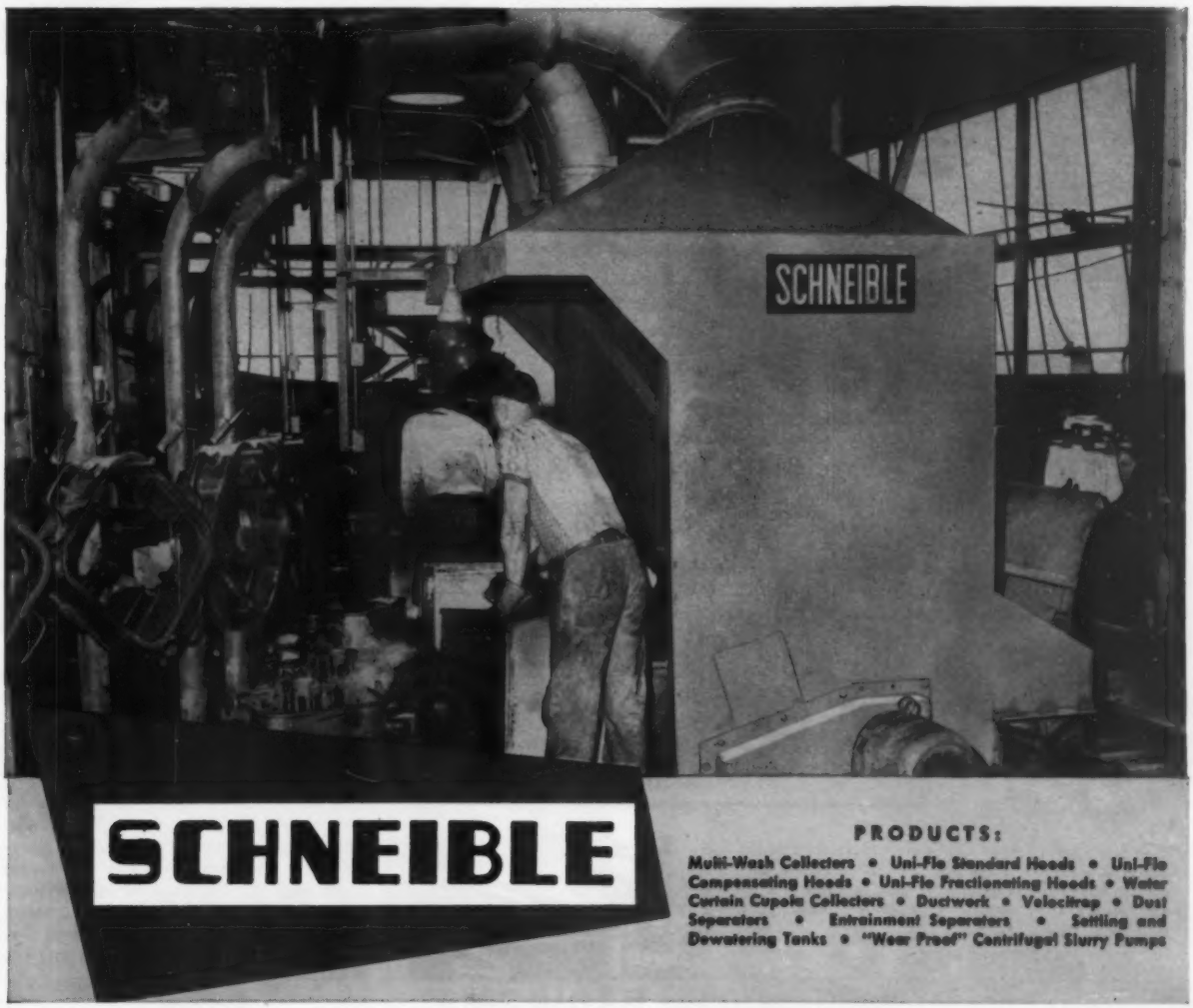

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Information

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Product Improvement

"New Horizons for Product Improvement," deals with the use of lightweight structural materials, including aluminum, magnesium and fiberglas, in contemporary product design. Methods of forming the metals are discussed, with particular stress placed on the sand and premanent mold casting processes. *Rolle Mfg. Co.*

For more data, circle No. 198 on p. 17

Heat Treat Furnaces

Booklet covering electric heat treat furnaces describes four types of electric heating elements and their methods of mounting. Also classifies heat treat furnaces according to their methods of handling stock. *Holcroft and Co.*

For more data, circle No. 199 on p. 17

Magnetism in Castings

Data Sheet, Stainless-3, "Magnetism in Cast Stainless Steel," points out the relative importance of magnetism in chromium and in chrome nickel stainless castings and wrought types. Chart gives the standard chemical composition ranges of the wrought and cast forms of Types 304 and 316 stainless and the bulletin shows how, within the standard composition range, the castability and magnetism of the steel can be varied. *Empire Steel Castings, Inc.*

For more data, circle No. 200 on p. 17

Facilities Available

A 32-page illustrated catalog describes the foundry and machine shop facilities available on a contract basis at Franklin Balmar Corp. Booklet also illustrates many of the different types of castings and machine shop products that have been completed for contract customers. *Franklin Balmar Corp.*

For more data, circle No. 201 on p. 17

Aluminum-Silicon Alloys

Revised Information Sheet No. 16 on Aluminum-Silicon Alloys lists uses, chemical composition, mechanical properties, heat treatment and casting characteristics. Melting considerations and melting procedure as well as casting temperatures and molding techniques are also considered. *Foundry Services, Ltd.*

For more data, circle No. 202 on p. 17

Rubberized Abrasives

Adaptability and application of rubberized abrasives, together with complete specifications is contained in illustrated Cratex Catalog No. 53. A feature of the catalog is the information on four standard grit types, ranging from relatively coarse to extremely fine textures, and the detailed application of each type to attain the desired end result on hard or soft metals and other materials. *Cratex Mfg Co.*

For more data, circle No. 203 on p. 17

Control Instruments

Bulletin F 5633-1, describes Wheelco Instruments for industrial process control application. Booklet contains a discussion of the electronic link, a no-contact linkage between the precision, direct measuring unit and the automatic control and recording system which gives instantaneous control and recording action. *Wheelco Instruments Div., Barber-Colman Co.*

For more data, circle No. 204 on p. 17

Correction

On page 88 of the March issue of AMERICAN FOUNDRYMAN a technical bulletin on grinding magnesium alloys was listed as being available to readers upon request. The number of this technical bulletin is 532, not 523 as listed. Data may be obtained by circling No. 163 of the March issue. Norton Co. publishes the bulletin.

CASTING through the Ages
In a typical FRENCH BRASS FOUNDRY OF THE EARLY 1700'S WORKERS SPENT 24 HOURS A DAY, 5 DAYS A WEEK AT THEIR JOBS! FOR THIS THE AVERAGE ASSISTANT RECEIVED ABOUT 12¢ A DAY — AND THE USE OF A ···· COUCH!
ABOUT THE MID-1800's CRAFTSMAN-FOUNDERS OF BERLIN, GERMANY, CAST IRON LINKS SO TINY THAT 180 OF THEM, LINKED TOGETHER MADE A CHAIN ONLY 4 FEET 10 INCHES LONG, WEIGHING ONLY 1⅔ OUNCES!
Odd Bits
···THE ORIGINAL FOUNDRYMEN OF AMERICA'S PIONEER SAUGUS IRON WORKS NEAR LYNN, MASS, IT IS SAID, WERE CALLED "HAMMERSMITHS"—NOT AS A DESIGNATION OF THEIR TRADE, BUT BECAUSE THEY CAME FROM THE ENGLISH TOWN OF·· HAMMERSMITH
FORBIDDEN··
BY THEIR RELIGIOUS BELIEFS TO CAST CANNON, THE QUAKER IRON FOUNDERS OF EARLY 18TH CENTURY COALBROOKDALE TURNED TO PRODUCING FIRE GRATES, BOILERS AND OTHER PEACEFUL UTENSILS ···

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Consult the MAY PRE-CONVENTION ISSUE for:

1 . . . complete Convention Program, direct from AFS Headquarters.

2 . . . abstracts of the papers to be presented at the technical-practical sessions.

3 . . . preview of the industry-wide exhibits.

4 . . . sales and convention messages from leading manufacturers and suppliers.

Official record of the AFS Foundry Congress and Foundry Show will be carried in the *June Post-Convention Issue*, which will virtually bring the Convention into the homes of those who attended the Meeting for a constructive review, plus a comprehensive recap for those foundrymen who did not personally participate in the 58th Annual Foundry Congress and Foundry Show.

Like the Pre-Convention Issue the JUNE POST-CONVENTION NUMBER

will be larger and more important than ever before. It will be replete with:

1 . . . on-the-scene photographs of convention events.

2 . . . reviews of the new processes and machines introduced to a progressively modern industry.

3 . . . official release of the trends, policies and forecasts that keynoted activities at this industry-wide get-together.

4 . . . messages from those companies seeking to be of service to the foundry field.

AMERICAN FOUNDRYMAN considers it a privilege to serve the foundry industry as the official monthly magazine of the American Foundrymen's Society . . . and AMERICAN FOUNDRYMAN can be relied upon to materially contribute to the success of the 58th Annual AFS Foundry Congress and Foundry Show by consistently supplying the industry with reliable information and help.

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ELECTROMET Data Sheet

A Digest of the Production, Properties, and Uses of Steels and Other Metals

Published by Electro Metallurgical Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. • In Canada: Electro Metallurgical Company, Division of Union Carbide Canada Limited, Welland, Ontario

COLUMBIUM and TANTALUM

Strategic Combination for Imparting Strength and Stability to High-Temperature Metals

Gas turbines for jet-aircraft engines, and for other similar engines being developed for marine and railway transportation, have greatly increased the demand for high-temperature metals. The present most satisfactory metals are either iron-base, nickel-base, or cobalt-base. They are used in the form of castings and hot-worked products, such as forgings, bars, and sheets.

Many of these special metals contain columbium because of its beneficial effect on high-temperature strength in both cast and wrought products. Investigations have shown that columbium is one of the key alloys for imparting high-temperature strength and stability in metals suitable for operating temperatures up to 1500 deg. F. and above.

Need for New Alloy

Originally, a ferrocolumbium alloy containing approximately 55 per cent columbium and 5 per cent tantalum was employed in the production of many of these high-temperature metals. However, with the increased use of high-temperature metals and columbium-bearing 18-8 stainless steels, it became necessary to utilize the tantalum-rich columbium ores.

ELECTROMET's Research Laboratories investigated whether an alloy containing more tantalum and less columbium would be equally satisfactory for producing the high-temperature metals. Columbium and tantalum alone, as well as combination alloys of columbium plus tantalum, were tested.

Results of Tests

The alloy N-155 was selected for tests. It is an iron-base alloy with the following approximate analysis:

Chromium	20 per cent
Nickel	20 per cent
Cobalt	20 per cent
Tungsten	3 per cent
Molybdenum	2 per cent
Columbium	1 per cent
Nitrogen	0.15 per cent
Carbon	max. 0.35 per cent

The data in the table below describe the mechanical properties, at room temperature, of this low-carbon N-155 alloy modified with columbium and tantalum alone, and with combinations of columbium plus tantalum. The metal modified with columbium has good strength and high ductility at room temperature. These same good properties are obtained when tantalum, or tantalum plus columbium, is substituted for the columbium.

Stress-to-rupture tests were also conducted on these same modified low-carbon N-155 alloys at 1350 and 1500 deg. F. The data show (see table) that when the columbium is replaced with a mixture of columbium plus tantalum, the strength of the metal remains substantially unaffected at 1350 and 1500 deg. F. Also, when all of the columbium is replaced with tantalum, the strength of the metal at 1500 deg. F. is equivalent to that obtained with columbium. Hence, from the standpoint of high-temperature strength, columbium and tantalum can be used interchangeably, or in combination.

Help to Industry

ELECTROMET has developed an alloy containing approximately 20 per cent tantalum and 40 per cent columbium for use in high-temperature metals and stainless steels. It is known as ELECTROMET ferrotantalum-columbium.

Industrial experience with this alloy has confirmed the favorable results of the experimental work. The alloy has already aided considerably in augmenting the supply of columbium alloys, since it is just as effective as ELECTROMET ferrocolumbium, with 50 to 60 per cent columbium, for giving strength at high temperatures.

It should be added to a thoroughly deoxidized metal bath to obtain the best results. A recovery of about 90 per cent for the columbium and 80 per cent for the tantalum may be expected.

For further information regarding alloys for high-temperature metals, write to the nearest ELECTROMET office: in Birmingham, Chicago, Cleveland, Detroit, Houston, Los Angeles, New York, Pittsburgh, or San Francisco. In Canada: Welland, Ontario.

Properties of Modified N-155 Alloys Compared*

Typical Analysis, %**	With Columbium	With Columbium and Tantalum		With Tantalum
Columbium	1.13	0.58	0.49	....
Tantalum	0.08	0.64	0.33	1.47
Carbon	0.12	0.13	0.13	0.12
Nitrogen	0.13	0.14	0.14	0.14
At Room Temperature				
Tensile Strength, psi	119,000	123,200	117,500	122,100
Yield Strength, psi	56,700	59,500	52,000	59,100
Elongation in 2 in., %	52	47	57	54
Reduction of Area, %	69	65	69	56
At 1350 deg. F.				
Stress to Cause Rupture, psi				
In 100 hr.	31,000	34,000	33,500	....
In 1000 hr.	23,000	25,000	23,000	....
At 1500 deg. F.				
Stress to Cause Rupture, psi				
In 100 hr.	20,000	20,000	20,500	20,000
In 1000 hr.	15,000	14,000	15,500	15,000

*Tests made on standard samples from one-inch round bars, water-quenched from 2250 deg. Fahrenheit.
**Composition of the base alloy is given in the text.

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DUST AND FUME CONTROL

continued from page 96

ICAN FOUNDRYMAN, March 1954, pp. 68-72.)

54-50 . . "Some Effects of Melting Furnace Amospheres on Tensile Properties and Annealability of Malleable Iron," G. E. Kempka and R. W. Heine, University of Wisconsin. Third progress report on AFS-sponsored research on influence of melting furnace atmosphere. Results include atmosphere and metal changes during melting; influence on mechanical properties of nitrogen (favorable), water vapor (unfavorable), free oxygen (unfavorable); effect of machining (complicated by three skin effects on unmachined bars); and effects on annealing, mottling, fluidity, and hot tear tendency.

54-55 . . "Correlation of Air Furnace Bottom Temperature to Refractory and Operating Practice in a Cupola-Air Furnace Duplex System," F. W. Jacobs and E. C. Ashley, Texas Foundries, Inc. Continuation of practical study reported in part at 1953 AFS Convention on variables affecting refractory bottom life in an oil-fired air furnace as related to bottom temperatures. Results and costs of refractories indicate that measurement of bottom temperature continues to be a definite aid in predicting bottom life. Particular emphasis is placed on treatment and control of slag.

54-68 . . "Effect of Plastic Deformation of Hard Iron on Subsequent Annealing," W. K. Bock, National Malleable & Steel Castings Co. Graphitization rate can be increased by plastic deformation of hard iron according to this investigation. It is demonstrated that graphitization rate can be increased by increasing the energy of white iron before annealing. Pearlitic rims, considered as material difficult to graphitize, can be overcome through plastic deformation.

Light Metals

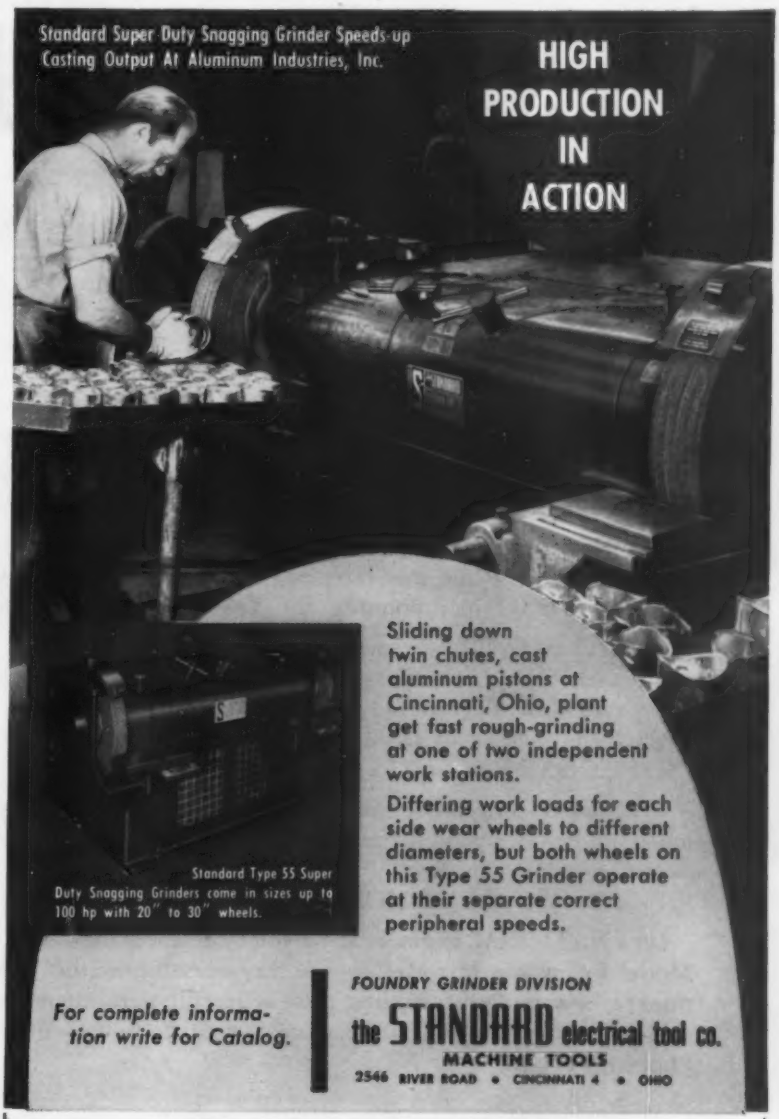
54-11 . . "New Aluminum Die-Casting Alloys," Donald L. Colwell and Edward Trela, Apex Smelting Co. Two modifications of No. 39 aluminum (SC84A) are suggested. The first, an increase in silicon to 11 per cent, has higher fluidity, better high temperature properties, and is favored for large area, thin-walled castings. The second, an increase in zinc to 2½ per cent, better utilizes available plant process scrap, and therefore is lower in price. It has improved machinability and equivalent castability. The increased silicon gives some increase in yield strength and hardness, the increased zinc has no effect on mechanical properties. The casting cycle need not be lengthened for either modification.

54-23 . . "Segregation in Magnesium-Rare Earth-Zinc-Zirconium Alloys," H. M. Skelly, Aluminum Laboratories Ltd., and D. C. Sunnucks, Aluminum Co. of Canada. Light areas on radiographs of EZ33 alloy castings are shown to be caused by eutectic segregation. A special test casting, in which segregation can be induced, was developed to assist in making a detailed study of the segregation. Tests show that the segregation may occur in other alloys and that: at room temperature, fatigue strength is not significantly affected, yield strength is unaffected, and ultimate tensile and elongation are slightly lowered; at 200 C, tensile properties are not affected and there is no loss of creep resistance under a stress of 6720 psi.

54-24 . . Mechanical Properties of Aluminum Die-Casting Alloys," C. O. Smith, Aluminum Co. of America. Data concerning static and dynamic properties of commercial aluminum die-casting alloys, including typical tensile properties at various temperatures, are given. Fatigue properties (rotating beam) are discussed and effects of as-cast and machined notches are illustrated. Some data concerning effects of machining on fatigue strength of die castings are presented. Examples of commercial applications, in which die castings are required to carry loads under dynamic stress, and tests to demonstrate suitability of these die castings, are described.

54-25 . . "Expendable Molds for Titanium Castings," R. M. Lang, J. Gissy, G. H. Schippereit, and J. G. Kura, Non-Ferrous Metallurgy Div., Battelle Me-

continued on page 112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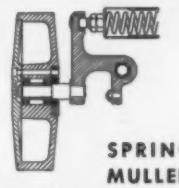

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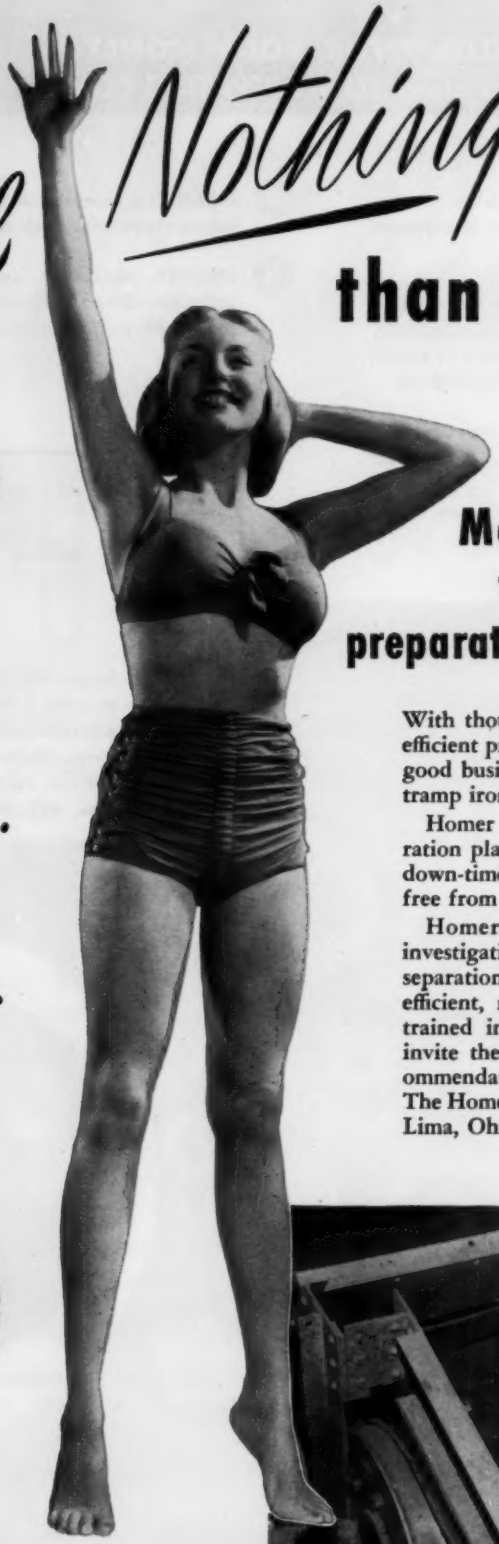

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Photo at right shows a 30" x 42" Homer Magnetic Pulley cobbing a mixture of iron ore and rock. This Homer unit is handling 110 net tons/hr., at a belt speed of 300 ft./min. Iron ore content is approximately 40%, with rock sizes from 3" x 6" down to fines.

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Foundry Congress and Show May 8-14, 1954

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The appeal of this 58th Annual Foundry Congress and Foundry Show stems from not one but, rather, the correct combination of events . . . technical sessions, round-table meetings, division luncheons and dinners, social events and hundreds of foundry product and service exhibits that will reflect the latest developments pertaining to modernization and economy of production in the foundry.

Here is a combination, therefore, that benefits an industry — a "team" that keeps the products of that industry in a position to compete in today's market and to figure prominently in tomorrow's progress. Being a part of such a winning combine through attendance at the Annual AFS Foundry Congress and Show is a bid for progress and industry recognition.

Activities

during the week of May 8-14, 1954, will exert far-reaching influences on the entire metal castings field— foundrymen and foundry interests are invited to attend the Foundry Congress and Show for the good that will result generally to all those interested in the manufacture and further refinement of cast products.

58*th Annual A.F.S. Foundry Congress and Show*

Cleveland—May 8-14, 1954

AMERICAN FOUNDRYMEN'S SOCIETY

616 South Michigan Avenue • Chicago, Illinois

Convention

continued from page 107

morial Institute. Graphite shell molds were the most satisfactory expendable molds developed thus far for casting titanium. Good surface finish and complete freedom from pinholes were obtained on section thicknesses up to and including two inches. All such castings, however, had surface layers of contaminated metal. Titanium cast in various refractory oxide shell molds showed pinholing which was reduced but not eliminated by inhibitors such as magnesium silicofluoride alone or with ammonium silicofluoride. All the mold materials contaminated the casting surface to some degree; contamination can be removed without loss of detail or adverse effect on surface finish by pickling in 50 per cent sulphuric acid containing 25 grams of ammonium bifluoride per liter of solution.

54-29 . . "Some Factors Affecting the Fatigue Strength of Aluminum Alloy Sand Castings," Marshall Holt, Aluminum Co. of America. Tests on cast plate-type specimens and machined "metallurgical type" test bars, separately cast or machined from the plates, showed: fatigue strength of plate specimens is lower, 6000 psi compared to 8700 psi; discontinuities, such as gas porosity, sand holes, and dross inclusions, ordinarily encountered in commercial aluminum alloy sand castings have no significant effect on fatigue strength; transverse metallic, and large dross inclusions detract slightly from the fatigue strength of otherwise commercially sound aluminum alloy sand castings; effects of sand holes depend on their size and locations—they reduce fatigue when located at an edge; effect of repairing a casting by welding depends on size and location of affected area—it appears that fatigue strength of a casting with sand holes at an edge can be increased by filling the holes with weld metal.

54-35 . . "Techniques for Producing Titanium Alloy Castings," Marvin Glassenberg and Morris J. Berger, Armour Research Foundation. A furnace for melting and casting titanium has been developed and a number of industrially important castings have been produced in zircon shell molds, dry silica sand molds, and graphite molds. (Will appear in May issue.)

54-36 . . "A Bottom-Pour Arc Furnace for Melting and Casting Titanium," O. W. Simmons, Rem-Cru Titanium Corp., and H. R. McCurdy and R. E. Edelman, Pitman-Dunn Laboratories, Frankford Arsenal. A furnace capable of melting and pouring at least a 10-lb heat free of contamination was developed. It consists of a water-cooled copper crucible and a separate mold cavity, the whole surrounded by a gas-tight chamber. Heat is introduced by a water-cooled, tungsten-tipped electrode; inert atmosphere is provided by an argon-helium mixture. Machined graphite formed the mold and molybdenum sheet acted as a plug to prevent premature pouring. Two special features incorporated in the mold chamber are resistance heaters which reduce the chilling effect of the mold, and an evacuating mechanism for drawing out gases at moment of pouring to supplement gravity.

54-37 . . "Technique for Improving Quality of Investment Castings," D. G. McCullough, F. J. Webbere, and R. F. Thomson, General Motors Corp. Plastic molds enabled authors to study fluid flow in investment casting mold cavities. Preferred runner design and risering technique for elimination of turbulence in the mold cavity and assurance of proper feeding were established by study of high speed motion pictures of flow characteristics. Also studied were runner design and casting arrangement for multiple-cast turbine buckets. Simple shapes were fabricated from commercial plastic sheet and tubing; irregular shapes were reproduced by casting a cold-pouring thermosetting resin around low-melting metal patterns which were subsequently melted from the mold.

54-38 . . "Mechanical Properties of Cast Titanium-Aluminum Alloys," R. E. Edelman and A. Tabak, Pitman-Dunn Laboratories, Frankford Arsenal. Mechanical properties of cast titanium-aluminum alloys were determined over a range from commercially pure titanium (0.0 per cent aluminum) to 6.0 per cent aluminum by weight. The ultimate tensile strength increased from approximately 70,000 psi to 135,000 psi, and the elongation decreased from 29 per cent to 10 per cent (1.4-in. gauge length) over this increase in aluminum content. No particular difficulty was encountered in casting these alloys, and the as-cast surfaces were reasonably free from cold shuts and laps.

54-42 . . "Gating and Risering of Magnesium Alloys," H. E. Elliot, Dow Chemical Co. Casting defects caused by faulty gating and risering can be minimized using the techniques developed by suppliers of magnesium alloy aircraft castings. (See pp. 56-62 this issue for Part 1; Part 2 will appear in May.)

54-66 . . "Beryllium in Magnesium Die-Casting Alloys," F. L. Burkett, Dow Chemical Co. Minute quantities of beryllium in magnesium alloys are effecting economies in die-casting operations by reducing oxidation losses in melting, transfer, and ladling of casting alloys. Beryllium as an Al-Mg-Be hardener is alloyed by convention methods. Beryllium in no way impairs castability, surface appearance, general surface and internal quality, mechanical properties, grain size, or salt-water and atmospheric corrosion resistance of magnesium die castings. By reducing melt losses, beryllium in magnesium die-casting alloys effects a further economic advantage in the application of magnesium to die-casting operations.

54-70 . . "Effect of Centrifugal Force on the Structure and Mechanical Properties of Aluminum Casting Alloy C4," O. Z. Rylski, A. Couture, and J. W. Meier, Physical Metallurgy Div., Department of Mines and Technical Surveys of Canada. Billets of C4 frozen without turbulence under conditions of directional solidification while lying along a radius of a spinning centrifugal casting machine show a characteristic zoned structure. The lower or outer zone consists of fine-grained, equiaxial crystals, has lower density and copper content, but less shrinkage and porosity than the upper zone. The latter had coarser equiaxial crystals and higher hardness but lower mechanical properties. Boundary between zones is sharp. At higher speeds of rotation, mechanical properties exceed those of billets cast under the same conditions without rotation.

Plant & Plant Equipment

54-49 . . "Development of Cupola Melting Equipment," W. R. Jaeschke, Whiting Corp. Cupola melting from 1700 to the present briefed, with detailed discussion of equipment used today. Covers conventional cupola, hot blast, balanced blast, charging equipment, slag disposal, moisture control, dust suppression, water cooling, and melting department layout.

Brass & Bronze

54-3 . . "Gating Yellow Brass Castings for Greater Production Economy," C. L. Mack, Chautauqua Hardward Corp. A flexible, effective approach to re-gating several hundred thin patterns was worked out by combining the author's experience and the recorded experiences of other foundrymen. (See pp. 70-74, this issue.)

54-5 . . "Some Factors Affecting Metal Penetration of Navy M Bronze in Cores," R. B. Fischer, Ingersoll-Rand Co. Report of investigation initiated in 1943 covers effects of sands, sand additives, and coatings. Test casting was devised which permitted comparison of seven specimens simultaneously. Author confirms that fluid metal pressure and permeability influence penetration markedly. Low permeability sand had best resistance to penetration and best mix was a fine grade of zircon sand (GFN 110). Sand additives showed some improvement in penetration resistance when added to low permeability base sands, but were not advantageous unless they drastically reduced permeability. Core washes improved surface finish if applied to a good penetration-resistant base sand, but would not completely eliminate penetration on high permeability sands such as 60 GFN silica sand.

54-21 . . "Application of Chills to Improving the Pressure Tightness of Gun Metal (88-8-4)," W. H. Johnson, H. F. Bishop, and W. S. Pellini, Metallurgy Division, Naval Research Laboratory. Feeding range of Gun Metal was evaluated on basis of pressure tightness developed in a bar casting at various distances from a riser. Measurements of the thermal gradients developed during the solidification of the casting provided information as to the degree of direction solidifica-

continued on page 116

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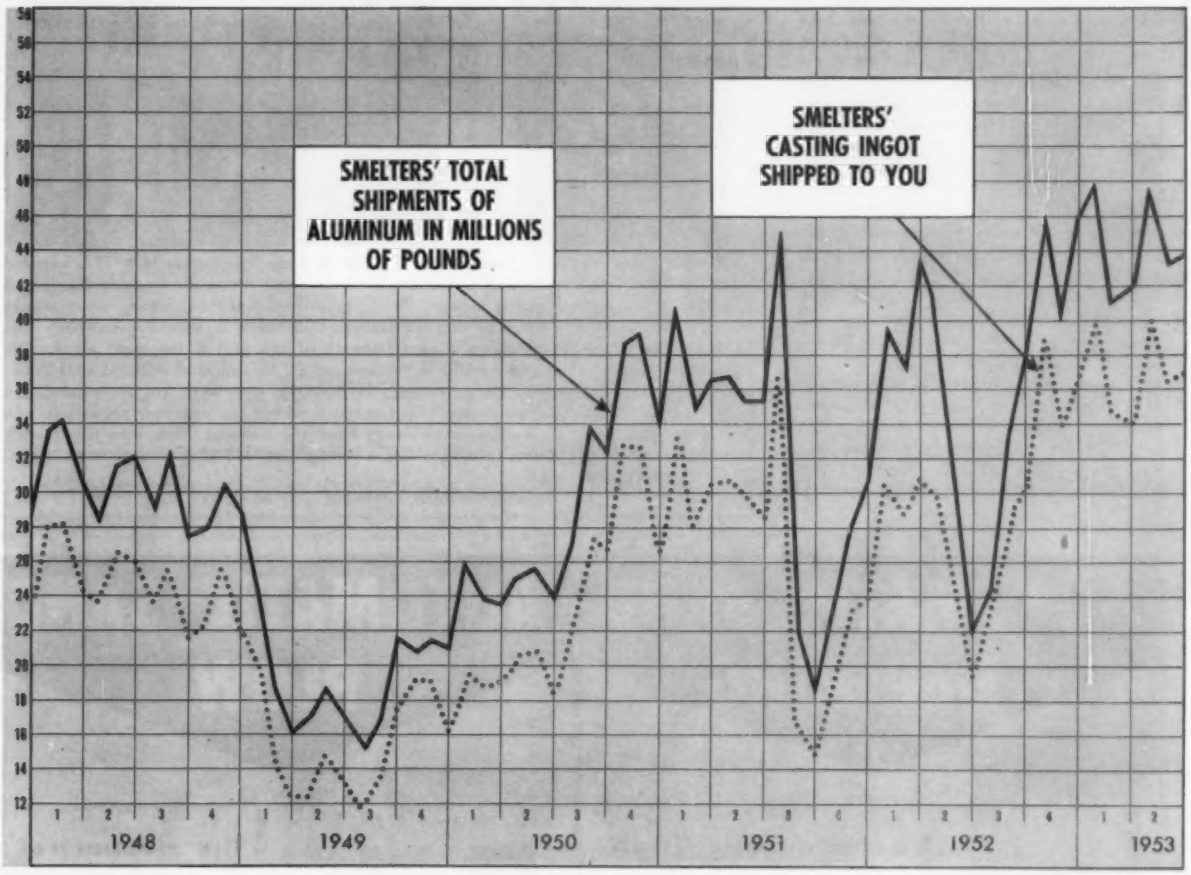

This chart — made from Bureau of Mines figures on total shipments made by smelters and smelters' own sales records of *casting ingot* shipped—shows at least 80 percent of our business is your business.

It proves graphically, as nothing else could do, that the present and future welfare of the foundryman and die caster is the major concern of his partner, the aluminum smelter. As a business man, the smelter knows that it is only good business to take care of customers who purchase 80 per cent of his production. This is your insurance policy — guaranteeing you a constant and dependable source of supply.

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He is a constant and dependable source of supply because he makes it his business to furnish casting ingots as you need them and when you need them.

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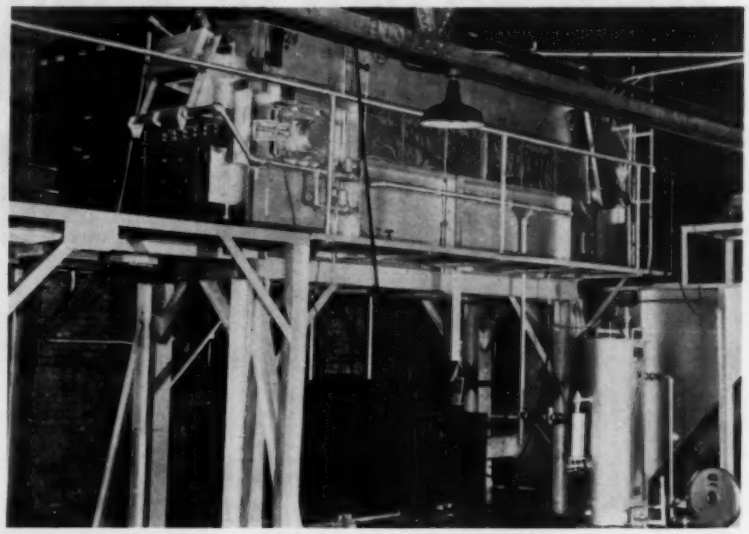
Metal Roll Book Published

Rolling Mills, Rolls and Roll Making is the title of a new 108-page book published by Mackintosh-Hemphill Co., pioneer Pittsburgh (Pa.) machinery and roll manufacturer. The case-bound book is well illustrated with 200 photos and drawings. The text covers metal rolling and roll-making techniques in both historical and modern aspects.

Foundry Safety Records Set

Two foundries have reported excellent accident frequency records for 1953. Cincinnati Milling Machine Co., Cincinnati, had a frequency rate of 3.11 disabling injuries per million man hours worked, compared with the national average for gray iron plants of 28.6 and an average rate in the Cincinnati area of 11.8. The company reports that supervisory groups carry the immediate responsibility for safety in the foundry.

In line with the safety contest among steel foundries during June, July and August of each year, the Chicago works of Continental Foundry & Machine Co. was awarded a certificate of achievement for the 1953 period, based on a frequency record for the three months of 2.25. The plant's annual frequency rate for the year was 7.75. The national rate for steel foundries is 22.5, which the group is attempting to cut in half.



Here's How the Saint Joseph, Mich., plant of Auto Specialties Mfg. Co., handled the problem of positioning a Lindberg electric conveyor atmosphere hardening furnace. Since the plant is located on sandy soil off Lake Michigan, water would be encountered if a pit was dug for the quench tank. In addition, mobility was desired to allow for subsequent repositioning of the unit if the need arose. The solution was to place the 17,400 lb furnace on an inexpensive scaffold that could quickly be dismantled. Large containers holding the work to be treated are hoisted to the loading platform by a lift truck where the operator shovels it into the furnace. After treatment, work drops from the conveyor belt into the quench tank where flight conveyor drops it into a steel chute leading to tempering baskets. *Lindberg Engineering Co.*

For more data, circle No. 207 on p. 17

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The Automatic Sand Tempering Unit adds the exact amount of tempering water to any type of sand in any type of sand mill.

RESULT Constant Moisture—Saves labor—Improves ease of molding—Saves castings.

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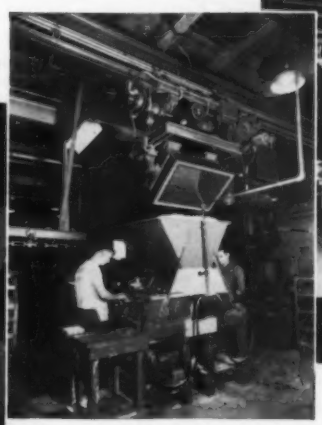

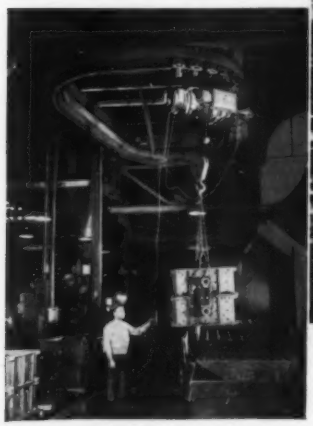

MonoTractor carrier serves shakeout from MonoRail loop

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Convention

continued from page 112

tion required to develop pressure tightness. Melt quality is shown to be an important factor—metal which contains gas requires a greater degree of directional solidification to produce soundness. By the application of chills in a novel manner it is possible to accentuate the degree of directional solidification to the extent that even gassy metal may be made pressure tight. This is demonstrated for the difficult case of thin-walled bushings which cannot be made consistently pressure tight even with good quality metal of low gas content when cast without chills. The usual practice of using end chills is demonstrated to be ineffective for purposes of increasing feeding range and overcoming the effects of gas.

54-79 . . "Some Experiences in the Shell Molding of Copper-Base Alloys," Howard K. Worner, University of Melbourne. Outline of some of fields in which shell molding can be effective in casting of copper-base alloys. Shell making is included but the paper is concerned more with problems of gating and feeding. Important aspects of design for shell-mold casting.

Measuring temperature of molten beryllium copper direct poured from electric furnace.

THE above is a "Furnace Type" Marshall Enclosed-Tip Thermocouple. This Thermocouple is made also in "Ladle Type."

THE nonferrous melt that is poured "as cold as practicable" is the one that makes castings dense, sound and with a minimum of shrinkage.

To pour at this "just right" heat you need close temperature control. Molten metal temperatures must be checked frequently in furnace or ladle. Then metals are poured when exactly right.

You can rely on Marshall Enclosed-Tip Thermocouples for this accurate temperature report. They enable you to take temperature of molten brass, bronze, aluminum or magnesium, dependably and with the least time-lag. The protected tip of this Thermocouple withstands many immersions. L. H. Marshall Co., 270 West Lane Avenue, Columbus 2, Ohio.

Marshall ENCLOSED-TIP THERMOCOUPLES

Industrial Engineering

54-16 . . "Educating Management of a Valuable Tool," John M. Taylor, Lester B. Knight & Associates, Inc. Few managements recognize the extensive use that can be made of time study and motion analysis information. Specification sheets combine standard data and job specifications and have two valuable functions, in addition to their use in incentive programs: they settle arguments relating to job content; they are a valuable tool for cost estimation. A program of six or seven meetings for key personnel conducted by the industrial engineer will insure full application of "spec sheet" information. Program is outlined.

54-33 . . "Analysis of Work Content, Time, Distance, and Speed at Conveyor Stations," Harry W. Bielefeld, Ford Motor Co. of Canada. Use of time-distance charts to answer questions that can't be answered from experience. Graphic representation simplifies industrial engineering problems in highly mechanized shops by showing interrelation of time and distance, multiple operators, interference delays, and idle time. Time-distance charts help sell proposals and organize thinking.

54-39 . . "A Measured Daywork Program," L. W. Lehmann, John Deere Van Brunt Co. Purpose of paper is to encourage the same caution in introducing new equipment and new methods on daywork jobs as on incentive jobs. Unless considerable work measurement goes into a job, economics incorporated in this equipment will be lost through negligent use of available manpower. Author shows how philosophy was applied to mechanical sweeping of shop to make maximum use of new equipment and to keep shop cleaner.

54-47 . . "An Incentive Plan for "Line" Supervisors," E. D. Bolden, Westover Engineers. Details of an incentive plan for the man between direct and indirect labor and top management who is often overlooked because incentives for supervisors are considered too difficult to administer. The plan considers all the factors largely within the control of the supervisors and reasonably measureable and shows how to weigh them.

Pattern

54-89 . . "Blow-in Driers," Robert Wendt, Industrial Pattern & Mfg. Co. Blow-in driers are improved shell driers constructed so that cores can be blown directly into them. They are useful for bulky or small intricate cores, make possible close dimensional tolerances, eliminate parting line separations, often eliminate need for core wires and nails, and minimize handling.

54-90 . . "Use of Plastics in Patternmaking," Wm. C. H. Dunn, Western Pattern Works. How an up-to-date pattern shop takes advantage of plastics in pattern production. Among advantages of plastics listed are: low cost duplication of patterns through repeated use of plas-

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Southeastern

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damental concepts and methods used in the past. Successful wet-reclamation methods were not devised until about 1938, he said; thermal systems followed shortly; and pneumatic installations were not described in the literature until 1948. Most of these systems were not free of various limitations for industry-wide acceptance.

He described the effect of various reclamation methods on sand grains. Reconditioning, he warned, treats the sand mass as a whole, does not affect the physical state of individual grains. Reconditioned sand may require less moisture and bond and be easier to control, but it cannot perform like new sand because surface conditions of old grains have not been restored.

Wenninger concluded that a uniform and controllable amount of work must be performed upon individual used sand grains in order to effect satisfactory reclamation. A satisfactory means of separation and classification may be applied to a sand mass as a whole to remove shell debris and other fines created in scrubbing grains, and to return reclaimed product with a grain distribution approximating that or the original new sand.

Safety Director Is Speaker

W. N. Davis, Safety Director, AFS, Chicago, spoke next on the Society's Safety, Hygiene & Air Pollution program. He indicated what each individual in the industry can do to prevent accidents and to improve conditions, thus helping to make the foundry a good place in which to work. Chairman of this session was H. M. Barker, U. S. Pipe & Foundry Co., Chattanooga.

On Friday morning, those attending the Conference were taken on tours of foundries located in the area, including: Eureka Foundry, Harriman Mfg. Co., Mueller Co., Ross-Meehan Foundries, Somerville Iron Works, Southern Shell Mold Eqpt. Co., Strickland Pattern Works, Tennessee Prod. Corp. Southern Ferro Alloy Plant, U. S. Pipe & Foundry Co., and Wheland Co.

K. L. Landgrebe, Wheland Co., was Chairman of this activity.

The afternoon sessions were opened by Chairman John Lasater, Combustion Engineering Co., Chattanooga, who introduced Prof. Warren Jeffery, University of Alabama, Tuscaloosa. Mr. Jeffery demonstrated a method for inspection and testing of castings by use of Cobalt 60. He showed the advantages of using the material over x-ray, that it saves time and produces a clearer picture.

Chairman Lasater then introduced Prof. E. C. Wright, also of the University of Alabama, who spoke enthusiastically about the F. E. F. plan of scholarships, which has proved so effective in helping young engineers through his school. He advised that the scholarship plan has worked better than the cooperation system. He also urged foundries to employ these students during vacation periods as a means of recruiting young engineers into the industry after graduation.

Glen Merrifield, Giffels & Vallet, Detroit, spoke on, "A Comparison of Present and Proposed Molding Machines." The Chairman of this session was Dave Shannon, Somerville Iron Works, Chattanooga. He listed reasons why the present design of molding machines had remained static and then described new designs, the processes where they would be most effective, and their limitations. He indicated that there are two primary reasons for keeping jolting to minimum: 1. to reduce the cycling time and increase production; and 2. to reduce the cycle so as to minimize wear on machines, flasks, and patterns. He explained new features on the sand slinger and described experiments being run on the so-called high pressure method of molding. Merrifield concluded by describing uses and sizes of flasks and the increased production that can be obtained from mechanization.

Paul Stuff, Ross-Meehan Foundries, Chattanooga, was chairman of the last session and introduced T. F. Kiley, Meehanite Metal Corp., New Rochelle, N. Y. Mr. Kiley gave a clear presentation of

continued on page 118

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Save cores and step up production. Guaranteed for 100,000 blows.

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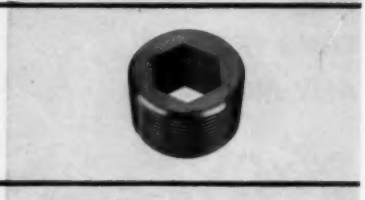
Stop abrasion between blow plate and core box. Protect blow holes.



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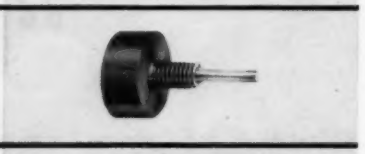

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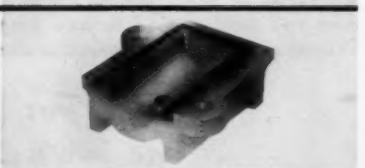

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Headquarters

continued from page 75

The following new contributions had been received during that time, with donations in addition to earlier amounts shown by asterisk (*):

Amrhein, N., Federal Malleable Co., West Allis, Wis.
*Brass & Bronze Ingot Institute, Chicago
Central Michigan Chapter, AFS
Cleveland Flux Co., Cleveland
Clio Foundry, Inc., Clio, Mich.
Crown Iron Works Co., Minneapolis
Dee Brass Foundry, Inc., Houston, Texas
*Deere & Co., Moline, Ill.
Eastern Canada Chapter, AFS, Montreal, Que., Can.
Huwiler, F. O., Federal Malleable Co., West Allis, Wis.
Liebau, C. L., Federal Malleable Co., West Allis, Wis.
Mitchell, Robert, Co., Ltd., St. Laurent, Montreal, Que., Can.
*Modern Equipment Co., Port Washington, Wis.
Nock Fire Brick Co., Cleveland
*Penola Oil Co., Detroit
Philadelphia Coke Co., Philadelphia
Pittsburgh Coke & Chemical Co., Pittsburgh, Pa.
Pohl, Stephen, Federal Malleable Co., West Allis, Wis.
Riley Stoker Corp., Detroit
Risney Foundry Equipment Co., Brookfield, Wis.
Stegemeyer, C. A., Federal Malleable Co., West Allis, Wis.
Woodliff, Earl E., Foundry Sand Service Engineering Co., Detroit

Southeastern

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gating and risering, using a series of slides. He indicated the problems that foundrymen can encounter by using poor gating methods, and explained that the fundamentals of gating are simple, but their application varies widely with the type of castings. It is a problem that frequently can tax the good judgment, ingenuity, and resourcefulness of the best foundrymen. Mr. Kiley concluded by showing that greater yields can be obtained from gating by using the correct method.

The Conference ended with the evening banquet, which attracted such a large group that some of the foundrymen had to eat in a separate room. The Hon. J. N. McCord, ex-Governor of Tennessee, was the principal speaker.

New British Headquarters

Foundry Trade Journal and associated publications will soon have new headquarters. A six-story building is under construction on the corner site of 17 and 19 John Adam St., and 1 York Buildings, Adelphi, London WC2.

Convention

continued from page 116

ter molds for casting plastics, elimination of finishing requirements, duplication without shrinkage compensation, smooth draw from sand, need for draft is eliminated, and surface wear is reduced to a minimum.

Heat Transfer

54-62 . . "Solidification of Various Metals in Sand and Chill Molds," F. A. Brandt, H. F. Bishop, and W. S. Pellini, Naval Research Laboratory. Solidification characteristics of various ferrous and non-ferrous alloys and pure metals cast in chill and sand molds are determined by thermal analysis. Thermal gradient conditions existing during solidification, and solidification curves, are illustrated. Heat transfer factors which determine relative solidification rates and solidification band features of various metals are discussed.

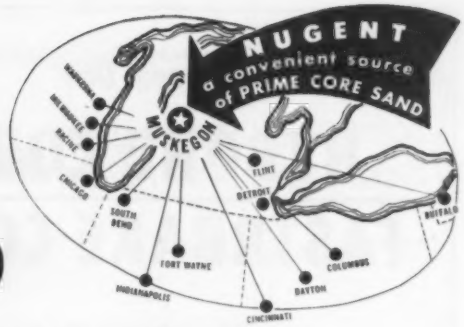
54-63 . . "Heat Transfer Characteristics of Metal Cast in Shell Molds," R. E. Morey, H. F. Bishop, and W. S. Pellini, Naval Research Laboratory. Solidification characteristics of metals cast in shell molds with backup are similar to those of sand castings. Without backup, differences dependent on specific conditions may develop. (See pp. 46-50 this issue.)

54-64 . . "Studies of Chill Action," E. T. Myskowski, H. F. Bishop, and W. S. Pellini, Naval Research Laboratory. Chills were applied to the center portion of long 4-in. x 4-in. bars cast of 0.30 per cent carbon steel and the resulting changes in solidification conditions were determined by thermal analysis. Effects of chill thickness and of removing the chill from direct contact with the casting by means of a sand spacing were investigated. It is demonstrated that chills applied directly to the casting develop essentially instantaneous skin formation and that at the chill edge there exists a narrow zone of sharp transition in solidification rates. This condition is considered to be responsible for chill-edge hot cracking. Use of a sand spacing causes a delay in chill action and prevents development of the sharp transition zone.

Plaster Mold Casting

54-19 . . "Improving the Thermal Conductivity and Economy of Foam Plaster Molds," Robert F. Dalton, formerly U. S. Gypsum Co. Foam plaster is advantageous in casting of thin aluminum such as automatic transmission parts because of its high permeability and low heat conductivity. The latter is a disadvantage with heavier metal sections but can be remedied by using external chills embedded in the foam plaster, or by using the plaster cores in semi-permanent mold operations. Another way is to increase mold density by mixing clean silica sand with the plaster.

FIVE GRADES of CORE SAND



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Chapter Meetings

April

1 . . Canton District
Mergus Restaurant, Canton, Ohio. Tom Barlow, Eastern Clay Products Co., "Cupola Refractories."

2 . . Western New York
Hotel Sheraton, Buffalo, N. Y. Tom Barlow, Eastern Clay Products Co., Chicago. "Latest Developments in Pressure Molding."

5 . . Central Illinois
American Legion Hall, Peoria, Ill. H. H. Wilder, Vanadium Corp. of America, Detroit, "Gray Iron Metallurgy."

5 . . Central Indiana
Athenaeum, Indianapolis, J. B. Caine, "Risering and Gating."

5 . . Chicago
Chicago Bar Association, Chicago, Round Table. Gray Iron, S. C. Massari, Hansell Elcock Co., Chicago, "Good Castings Cheaper." Malleable, J. F. Kruger, International Harvester Co. "Improved Methods and Lower Cost." Non Ferrous, Steel Patt., Panel Discussion "Casting Design." Maintenance, H. D. Krummel, Socony Vacuum, "Foundry Lubrication."

5 . . Metropolitan
Essex House, Newark, N. J. Tom Muff, Sorbo-Mat Process Engineers, "Phases of Foundry Control."

5 . . Western Michigan
Bill Stern's Restaurant, Muskegon Heights, Mich. William Ferrel, Auto Specialties Mfg. Co., "D Processing Molding."

6 . . Rochester
Seneca Hotel, Rochester, N. Y. A. F. Pfeiffer, Allis-Chalmers Mfg. Co., "Coordinative Function of Pattern Equipment and Castings."

8 . . Northeastern Ohio
Tudor Arms Hotel, Cleveland. Ray A. Witschey, A. P. Green Firebrick Co., "Refractories."

9 . . Texas
Lufkin, Texas.

9 . . Philadelphia
Engineers' Club, Philadelphia, William Crawford, Liberty Mutual Insurance Co., "Safety in the Foundry."

9 . . Wisconsin
Hotel Schroeder, Milwaukee. Sectional Meeting.

12 . . Michiana
Warsaw, Ind. Entertainment Meeting. Dan Leedy, Dalton Foundries, Warsaw, Ind., in charge.

13 . . Twin City
Covered Wagon, Minneapolis. Carl W. Sundberg, Minneapolis Electric Steel Castings Co., Minneapolis, "Better Casting Finish Through Tighter Sand Control."

18 . . Detroit
Detroit Leland Hotel, Detroit. Moderator, Cliff Hockman, Cadillac Motor Div., Detroit, "Molding Methods—Should you use "C" process, "D" process, dry sand, green sand, or permanent mold?"

Chapter Meetings

21 . . Central Michigan

Hart Hotel, Battle Creek, Mich. Harry W. Dietert, Harry W. Dietert Co., and Warner B. Bishop, Archer-Daniels-Midland Co., "The 'D' Process."

21 . . Oregon

Heathman Hotel, Portland, Ore. Wm. Romanoff, H. Kramer & Co., Chicago, "Brass & Bronze Foundry Practice."

23 . . Birmingham

University of Alabama, Tuscaloosa, Ala.

23 . . Chesapeake

Engineers Club, Baltimore, Md. F. L. Riddell, H. Kramer and Co., Chicago, "Brass and Bronze Foundry Practice."

23 . . Ontario

Royal Connaught Hotel, Hamilton, Ont., Canada. Dr. W. C. Winegard, University of Toronto.

24 . . Michiana

Athenian Room, Hotel Elkhart. Dinner Dance.

26 . . Northwestern Pennsylvania

Moose Club, Erie, Pa. W. G. Parker, General Electric Co., Elmira, N. Y., "Green Deformation in Molding Sand as an Aid to Sand Control."

May

3 . . Western Michigan

Cottage Inn, Muskegon, Mich. Joseph S. Schumacher, Hill & Griffith Co., Cincinnati, "Fool Proof Sand."

3 . . Central Illinois

American Legion Hall, Peoria, Ill. W. H. Hisey, Goodyear Tire & Rubber Co., Akron, Ohio, "The Road Back."

3 . . Central Indiana

Athenaeum, Indianapolis, Ind. Howard Wilder, Vanadium Corp. of America, "Recent Developments in Cupola Control."

3 . . Chicago

Chicago Bar Association, Chicago. Annual Business Meeting.

4 . . Rochester

Seneca Hotel, Rochester, N. Y. Election of Officers.

6 . . Saginaw Valley

Fischer's Hotel, Frankenmuth, Mich. Round Table Meeting. Ferrous, "High Pressure Molding." Light Metals, C. L. Wheeler, Aircraft Engine Div., Ford Motor Co., "Comparison of Al and Mg Foundry Characteristics."

14 . . Texas

Galveston, Texas

18 . . Twin City

Panel Discussion.

19 . . Central Michigan

Hart Hotel, Battle Creek, Mich. Ben Taylor, B. F. Goodrich Co., "Today's Challenge in Human Relations."

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A389 .. "Oxidized Iron," W. J. Williams, *Journal of Research and Development, B.C.I.R.A.*, vol. 5, no. 2, October 1953, pp. 41-44.

Additions of red and magnetic oxides of iron to a high-carbon, low-silicon iron increased the oxygen content but did not have any appreciable influence on the chilling characteristics as indicated by the chill test used.

A390 .. "Gas Analyses of Cast Iron Produced at Various Foundries," B. B. Bach, *Journal of Research and Development, B.C.I.R.A.*, vol. 5, no. 2, October 1953, pp. 45-70.

Chill cast samples of cast iron and pig iron were gathered from 12 foundries and analyzed for oxygen, hydrogen, and nitrogen. No significant variation in hydrogen was detected but oxygen and nitrogen varied with the composition of iron and the melting unit and also varied from day to day in the same foundry.

A391 .. "Temperature Cycles of Enamelled Castings During the Process of Enamel Fusing," E. R. Evans, *Journal of Research and Development, B.C.I.R.A.*, vol. 5, no. 2, October 1953, pp. 78-92.

Temperature cycles in enamelling of batches of castings heated by gas, oil, coal, electricity, as well as by continuous electric furnace were studied, along with incidence of blistering.

A392 .. "Shell Molding of Stainless Steel," Walter H. Dunn and Robert E. day, *Product Engineering*, vol. 24, no. 9, September 1953, pp. 129-133.

Describes shell mold production of aircraft components, gives important factors in design of shell-cast stainless parts, compares shell molding with other methods of production.

A393 .. "Melting Practice for Investment Casting," Sam Tour, *Precision Metal Molding*, vol. 11, no. 10, October 1953, pp. 64-65, 91, 92, 93, 94, and vol. 11, no. 11, November 1953, pp. 40-41, 83, 84, 85, 86, 87.

Describes and illustrates melting equipment, discusses contamination and melting losses, refractories and crucibles, and temperatures.

Abstracts

A394 . . "Flow Properties of Foundry Sand," J. Gittus, *Iron & Steel*, vol. 26, no. 11, October 1953, pp. 475-478, vol. 26, no. 12, November 1953, pp. 501-506, vol. 26, no. 13, December 1953, pp. 551-553.

Various methods of estimating flowability of sand are considered. Some, though widely different, give results related to the Bond Energy Ratio—the ratio of the work done in compacting the sand to that required to break it up again. Practical implications of BER are discussed.

A395 . . "Graphite Spherulite Formation and Growth," Albert DeSy, *Foundry*, vol. 81, no. 11, November 1953, pp. 100-103, 210, 212, 218, 220.

Tentative theory plus experimental results which illustrate a mechanism of spherulite formation and growth in nodular iron.

A396 . . "Large Wood Patternmaking," M. J. Kellner and G. H. Gorsuch, *Foundry*, vol. 81, no. 11, November 1953, pp. 104, 282, 283, 284, 285.

Classes of patterns, use of scale models, construction details, and pattern coatings are discussed.

A397 . . "Electric Annealing of White Iron," Richard W. Parsons, *Foundry*, vol. 81, no. 11, November 1953, pp. 112-115.

Tells how second-stage anneal was controlled to malleablize conventional white iron compositions in a 48-hr cycle.

A398 . . "Aluminum Foundry has Three Strings for Its Bow," Edwin Bremer, *Foundry*, vol. 81, no. 11, November 1953, pp. 116-119, 290, 291.

Plant write up of foundry which produces aluminum castings in green sand, permanent molds, and shell molds.

A399 . . "Automatic Control of Sand Moisture," Erle F. Ross, *Foundry*, November 1953, vol. 81, no. 11, pp. 120-123, 184.

Sand handling and conditioning system in 135-ton a day gray iron shop features automatic moisture control and bond additions.

A400 . . "Back-up Material for Shell Molds," William O. Faxon, *Foundry*, vol. 81, no. 11, November 1953, pp. 178, 180, 183, 184.

Selection and handling of shell mold backing materials.

A401 . . "Mold Blower Provides High Production Rate," *Foundry*, vol. 81, no. 11, November 1953, pp. 190, 192.

Tells how one operator turns out 750 mold sections in eight hours using new type blow-squeeze machine.

A402 . . "Shell Molding is Coming of Age," Lyle L. Clark, *The Frontier*, December 1953, pp. 14-18.

Problems and advantages of shell molding.

A403 . . "Effect of Stripping Time on the Structure of Chill-Cast Irons," G. J. Shaw and V. Kondic, *Foundry Trade Journal*, vol. 95, no. 1937, October 15, 1953, pp. 473-478.

Gray and nodular irons were cast in chill molds as 1.25-in. diam. bars. Authors conclude that certain forms of graphite in gray iron can form in solid state.

A404 . . "American Arc-Furnace Practice," W. B. Wallis, *Foundry Trade Journal*, vol. 95, no. 1938, October 22, 1953, pp. 507-511.

History of use of direct arc furnaces and their present status in United States foundries and steel works.

A405 . . "Application of External Dust Control to a Standard 24-in. Pedestal Grinder," W. H. White and W. B. Lawrie, *Foundry Trade Journal*, vol. 95, no. 1937, October 15, 1953, pp. 481-487.

Dust observations and determinations which led to control system for 24-in. diam. grinding wheel running at peripheral speed of 9000 fpm.

A406 . . "Designing an Iron Foundry," Donald Appleyard and Stephen Rosenberg, *Foundry Trade Journal*, vol. 95, no. 1942, November 19, 1953, pp. 619-621.

Iron foundry design developed by two students of architecture to meet needs of an existing manufacturing operation.

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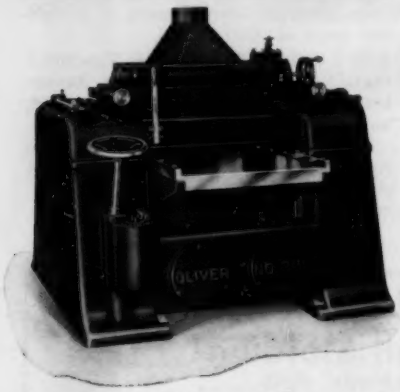

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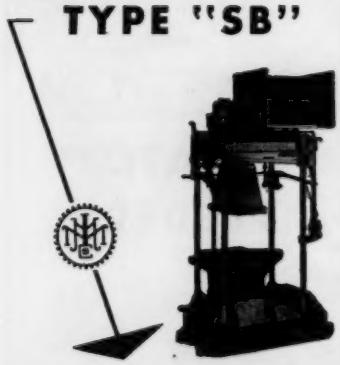

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Abstracts

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A407 . . "Gating to Control Pouring Rate and Its Effect on the Casting," F. J. McDonald, *American Foundryman*, vol. 24, no. 6, pp. 36-41.

Development of pouring rate controls as part of quality control program.

A408 . . "Catalytic Combustion Control in Core-Baking Oven," R. J. Ruff, *American Foundryman*, vol. 24, no. 6, December 1953, pp. 42-44.

Describes plant installation of control unit for objectionable, explosive core oil vapors.

A409 . . "Use of Gamma-Ray Emitters for Industrial Radiography," Herbert R. Isenburger, *American Foundryman*, vol. 24, no. 6, December 1953, pp. 46-48.

Use of radioactive isotopes for nondestructive testing. Includes exposure chart for steel using Co^{60} and Ir^{192}.

A410 . . "Foundry Industry Looks at Apprentice Training," R. G. Greiner, *American Foundryman*, vol. 24, no. 6, December 1953, pp. 50-53.

Advantages of apprenticeship to both apprentices and to industry.

A411 . . "Repairing Conveyor Belts," A. F. Matheis, *American Foundryman*, vol. 24, no. 6, December 1953, pp. 56-58.

How-to-do-it article with step-by-step illustrations of conveyor belt repair.

A412 . . "Riser Range and Feeder Adequacy," William S. Pellini, *American Foundryman*, vol. 24, no. 5, November 1953, pp. 58-66, vol. 24, no. 6, December 1953, pp. 62-71.

Fundamental study of casting solidification and riser action. Includes quantitative data on riser feeding distances for steel castings of various simple shapes.

A413 . . "Smoke, Dust, Fumes Closely Controlled in Electric Furnaces," R. S. Coulter, *Iron Age*, vol. 173, no. 2, January 14, 1954, pp. 107-110.

Description, data, and diagrams showing how three large direct arc furnaces meet Los Angeles County air pollution codes.

A414 . . "Foundry Core Sand Delivered by Air," E. J. Egan, Jr., *Iron Age*, vol. 173, no. 3, January 21, 1954.

Pneumatic core sand handling system transports 960 tons of prepared sand in two-shift day. Mullers mix one-ton batches in continuous automatic cycle.

A415 . . "Rational Foundry Management," F. Buckley, *Foundry Trade Journal*, vol. 96, no. 1951, January 21, 1944, pp. 63-69, vol. 96, no. 1952, January 28, 1954, pp. 103-106.

Operations and their management in a large jobbing foundry producing castings from a few pounds to 30 tons for diesel and electric power generation equipment.

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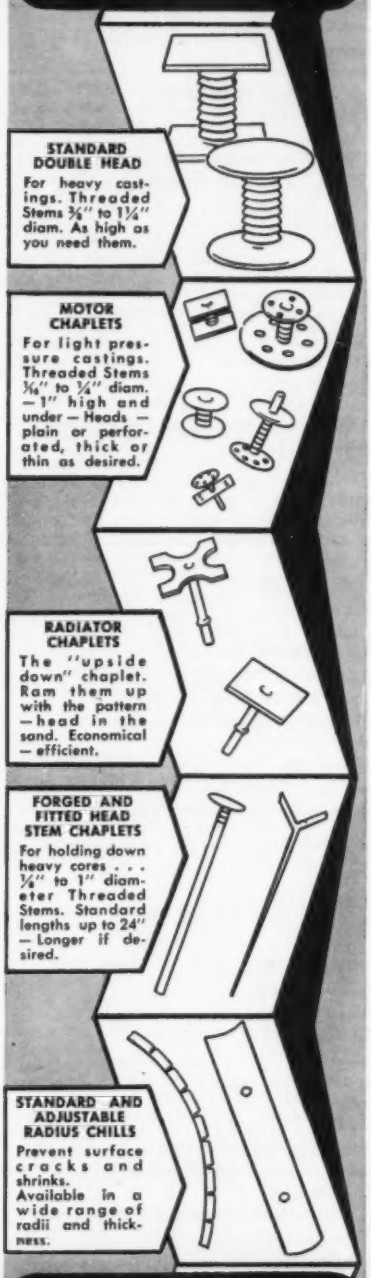

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The night man gets the blame . . .
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The night men done it!
If we go to work and the clock won't ring
The night men done it!
If the oven smokes, if the cores are green,
If there's something wrong with the molding machine,
If a link core blows or a mold ain't clean,
THE NIGHT MEN DONE IT!

If we find a mold with the heads caved in,
The night men done it!
If that rammer's acting up again,
The night men done it!
If a pattern is rough, if the sand's too dry,
If the sand mill's down and we don't know why,
If we have to work on the Fourth of July,
THE NIGHT MEN DONE IT!

Do you know who picked my tool-box lock?
The night men done it!
Who broke the glass on the front of the clock?
The night men done it!
At home, my radio's out of tune,
There are spots on the wall of my living room,
There'll be a new baby up at my house soon—
But who am I to jump at conclusions?

From Rammed Up and Poured, book of foundry poems by Bill Walkins, obtainable from the copyright owners: Electric Steel Foundry Co., 2141 North West 25th Ave., Portland 10, Oregon. Price, $1.85.

Furnace Association Elects Officers

The Industrial Furnace Mfrs. Assn. elected new officers and directors at its Philadelphia meeting, January 25-26. L. H. Gillette, Westinghouse Electric Corp., was elected president and director of the group. He succeeds Curt H. Vaughan, Electric Furnace Co., Salem, Ohio, who was elected to the executive committee.

Carl L. Ipsen was re-elected executive vice-president. Also re-elected was Ralph E. Whittaker, treasurer.

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THE SESSIONS FOUNDRY CO.

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(Rt. 6—17 Miles from Hartford)
On the Premises

TUESDAY, APRIL 6, 1954 AT 10:00 A.M.

FOUNDRY MACHINERY
WHITING Skip Hoist Charger, 46 x 48 Bucket, 3000 lb. Cap. • AMERICAN WHEELABRATOR Barrel Tum-Blast—Skip Bucket—Skip Bucket Loader and 86" Table, 5000 Lb. Cap. complete • HERMAN Rollover Molding Mach. • BEARDSLEY & PIPER SAND Slinger and Sand Conditioner • OSBORN Jolt Squeezers • "HANDY SANDY" Double Hopper • FISHER Aluminum Melting Furnace • 6-16 Ton/hr. Cupolas • KWIK MIX Motor Barrows • Sand Mold Dryers, Dust Collectors, Sand Blenders, Ladles, Flasks. Many other items too numerous to mention.

MATERIALS HANDLING EQUIPMENT
CLEVELAND Overhead Tramrail Crane • COBURN Overhead Trolley • Narrow Gauge Rail W/13 Turn Tables • Jib Cranes • HYSTER, YARDMAN, YALE Lift Trucks • INTERNATIONAL Tractor • FORD Dump Truck • FARQUHAR, HAISS Undercar Unloaders • Many other items.

MACHINE TOOLS
BROWN & SHARPE—BULLARD—CINN.—HENDY—JONES & LAMSON—PRATT & WHITNEY—KALAMAZOO—STANDARD Milling Machines, Lathes, Drills, Snaggers, Planers, Saws, Etc.

COMPLETE WOODWORKING SHOP

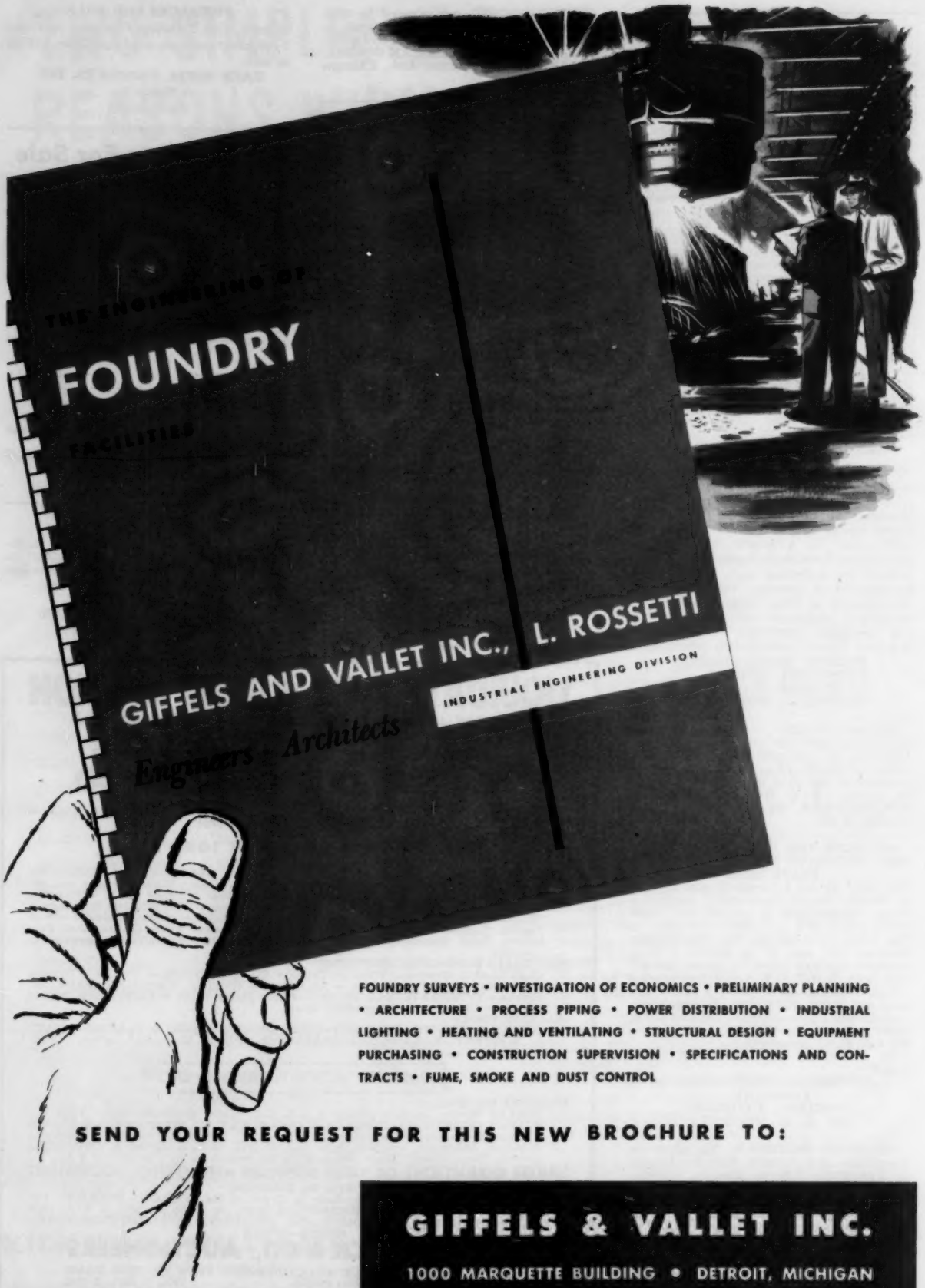
FACTORY EQUIPMENT
FULLER Rotary Air Compressor • G.E. D.C. Motor Generator Set • P & H—BUDGIT—FORD & YALE Hoists • Scales • ROCKWELL Hardness Tester • L & N Pyrometer—Galvanometer—Moisture Testers • Pneumatic chippers, Hammers, Grinders, Rammers, etc. 1-75 H.P. A.C. & D.C. Motors 220/440 & 230V. Water Coolers, Time Clocks. Many other items too numerous to mention.

LARGE QUANTITIES OF NEW SUPPLIES AND OFFICE EQUIPMENT
(Write for Catalogue)

TERMS: Cash or Certified Check—Sale by Order of the SESSIONS FOUNDRY CO. PLANT WILL BE OPEN FOR INSPECTION MON. & TUES. APRIL 5 & 6, 1954. FOR FREE DETAILED CATALOGUE AND ADDITIONAL INFORMATION WIRE—PHONE—WRITE

AARON KROCK & CO., AUCTIONEERS

THE ORIGINAL AND ONLY AUCTIONEERING FIRM BY THIS NAME
288 MAIN ST., WORCESTER, MASS. TEL. 3-7261, 3-7262
EST. SINCE 1915 GREATER RESULTS THRU EXPERIENCE



FOUNDRY SURVEYS • INVESTIGATION OF ECONOMICS • PRELIMINARY PLANNING • ARCHITECTURE • PROCESS PIPING • POWER DISTRIBUTION • INDUSTRIAL LIGHTING • HEATING AND VENTILATING • STRUCTURAL DESIGN • EQUIPMENT PURCHASING • CONSTRUCTION SUPERVISION • SPECIFICATIONS AND CONTRACTS • FUME, SMOKE AND DUST CONTROL

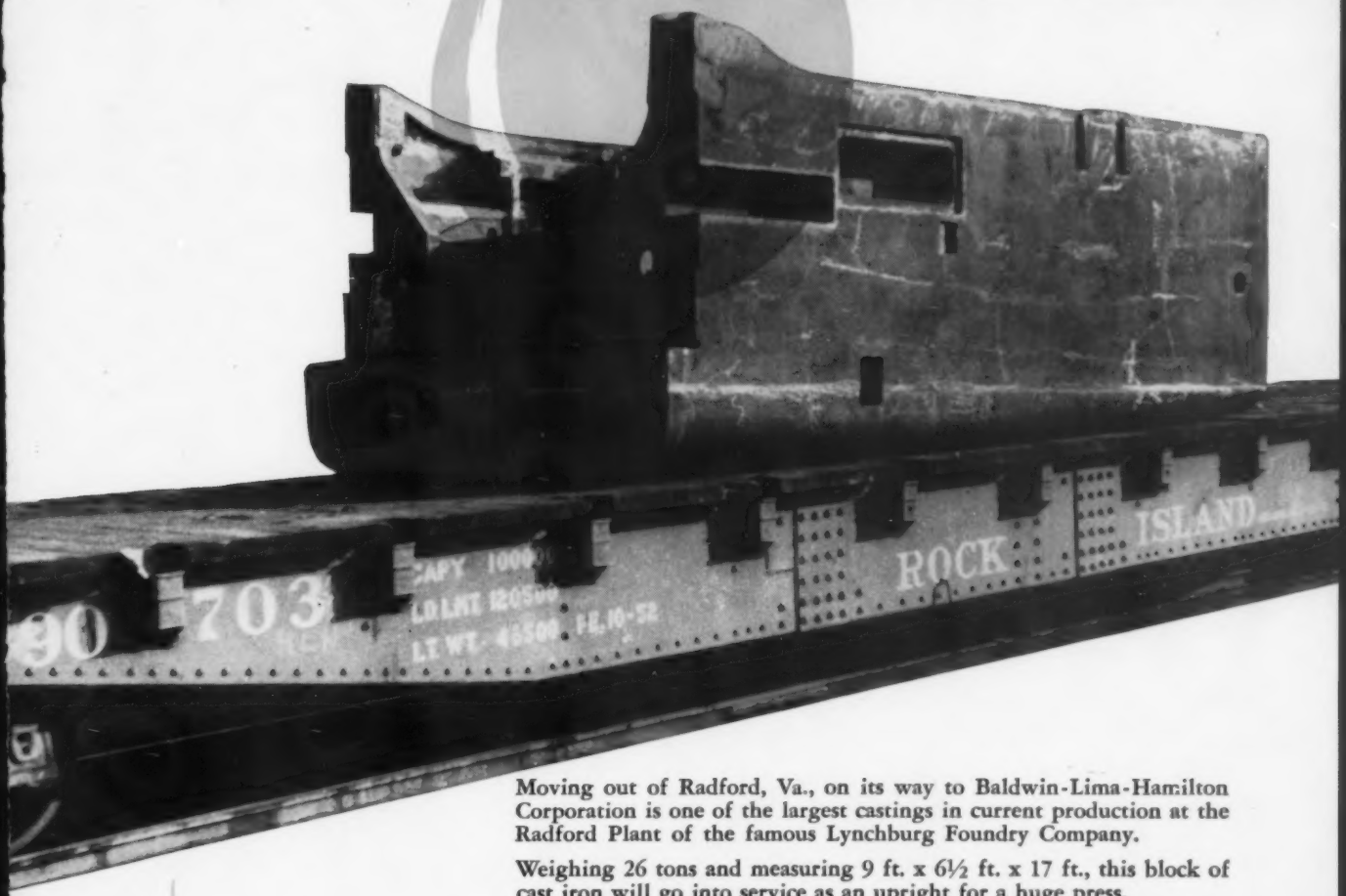
SEND YOUR REQUEST FOR THIS NEW BROCHURE TO:

GIFFELS & VALLET INC.

1000 MARQUETTE BUILDING • DETROIT, MICHIGAN

Gigantic casting by Lynchburg Foundry Co.

takes 118 gallons of LINOIL



Moving out of Radford, Va., on its way to Baldwin-Lima-Hamilton Corporation is one of the largest castings in current production at the Radford Plant of the famous Lynchburg Foundry Company.

Weighing 26 tons and measuring 9 ft. x 6½ ft. x 17 ft., this block of cast iron will go into service as an upright for a huge press.

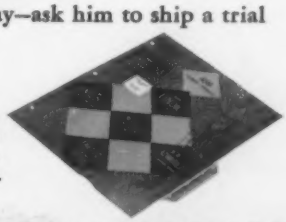
The cores used in producing this casting tip the scales at 35 tons! When you estimate the time, manpower, and materials involved, you can imagine the responsibility placed upon the core department.

Lynchburg Foundry, whose skill is universally recognized, has found that LINOIL is good insurance against faulty cores. Rigid quality control keeps LINOIL uniform, shipment after shipment.

Why not call your ADM Representative today—ask him to ship a trial drum of LINOIL to your plant.

AVAILABLE TO FOUNDRIES...

continuous Technical Information Service on the latest developments from the ADM Sand Laboratory. Furnished in handy file folder form for quick reference. A request on your letterhead will put your name on our Technical Information mailing list.



ARCHER • DANIELS • MIDLAND COMPANY

FOUNDRY PRODUCTS DIVISION • 2191 WEST 110th ST. • CLEVELAND 2, OHIO

protect your profits with

APEX ... Z-50

ALUMINUM ALLOY

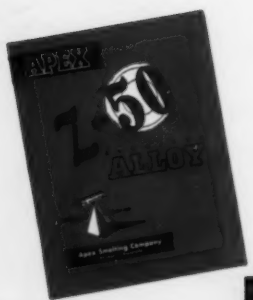
QUALITY AND ECONOMY

tested and proved on the job

Above average mechanical properties, uniform casting characteristics and free machinability make Z-50 aluminum alloy developed by Apex an outstanding money saver on your production line.

Fulfilling the foundry's need for a quality all-purpose alloy, Apex Z-50 polishes and buffs to a satin finish, has excellent response to anodizing and other chemical and electrochemical finishes. Its as-cast properties are right for most castings, it may be treated for highly stressed castings, and it provides superior dimensional stability with an aging treatment.

Apex Z-50 is another superior product of Apex research and scientifically controlled production, tested and proved in the foundry field and in final application.



Send for your copy of Apex Z-50 folder showing composition, physical properties, and permanent mold and sand cast mechanical properties.

Research leadership back of every ingot

APEX SMELTING COMPANY

CHICAGO • CLEVELAND • LOS ANGELES